Drop Test - - Cessna Golden Eagle 421B

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Technical Center
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16. Abstract

This report presents the results of two airplane vertical impact tests conducted at the Federal Aviation Administration (FAA) Technical Center, Atlantic City International Airport, New Jersey. These tests entailed dropping a low wing, twin engine Cessna 421B aircraft from a vertical height of 11.2 feet, resulting in an impact velocity of approximately 26.0 feet per second (ft/s). In both tests the aircraft was configured to simulate actual in-flight conditions including seats, occupants, and fuel. The structural response of the airframe, seats, and simulated occupants (anthropomorphic dummies) were measured throughout the tests, and the results are presented in this report. The data collected in these tests and future tests of other commuter type aircraft will provide the basis for improved seat standards for commuter airplanes.

These tests describe the impact response characteristics of commuter category airplane airframes, floor structures, seats, seat attachments and occupant restraint systems.

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EXECUTIVE SUMMARY

A Cessna 421B aircraft was subject to a vertical impact test at the Federal Aviation Administration Technical Center in Atlantic City, N.J. The aircraft was used for two tests. Two tests were possible because there was no significant damage to the fuselage during the first test. The purpose of the tests was to measure the structural response of the fuselage, floor, seats, and occupants. The tests were conducted to simulate potentially survivable impact conditions of actual crashes. In both tests the aircraft was dropped from approximately 11 feet and was configured to simulate full passenger occupancy.

Accelerations, loads, and deflections were measured throughout the test by accelerometers, load cells, and string potentiometers. These instruments were located on the fuselage, floor, seats, and in anthropomorphic test dummies.

INTRODUCTION

PURPOSE.

This report presents the results of two airplane vertical impact tests conducted at the Federal Aviation Administration (FAA) Technical Center, Atlantic City International Airport, New Jersey. These tests entailed dropping a low wing, twin engine Cessna 421B aircraft from a vertical height of 11.2 feet, resulting in an impact velocity of approximately 26.0 feet per second (ft/s). In both tests the aircraft was configured to simulate in-flight conditions including seats, occupants, and fuel. The structural response of the airframe, seats, and simulated occupants (anthropomorphic dummies) were measured throughout the tests, and the results are presented in this report. The data collected in these tests and future tests will provide the basis for improved seat standards for commuter airplanes.

BACKGROUND.

The FAA Technical Center is involved in aircraft structural research focusing on enhancing occupant safety in a postcrash environment. In those accidents where the fuselage maintains a habitable space, the energy absorption characteristics of the airframe structure and the structural performance of the seat/restraint system are paramount to occupant safety.

The tests described in this report are two in a series of tests to understand the impact response characteristics of commuter category airplane airframes, floor structures, seats, seat attachments and occupant restraint systems.

DESCRIPTION

TEST FACILITY.

The Technical Center drop test facility, figure 1, is comprised of two 50-foot vertical steel towers connected by an elevated platform. A fixed mounted electric power winch on the platform is controlled from the base of one of the tower legs. The tower and lifting capacity of the winch is rated at 25,000 pounds. Attached to the winch is a reeved hoisting cable which is used to raise the test article. A sheave block assembly hanging from the free end of the reeved cable is, in turn, engaged to a solenoid operated release hook. The release hook is connected to the airframe by a cable/turnbuckle sling assembly. Located directly below the winch cable assembly and between the tower legs is a 15- by 36-foot wooden load-measurement platform which rests upon I-beams and 12 interconnected 50,000-pound load cells. At impact, the output of each load cell signal is summed through a sum/amplifier system arrangement.

Prior to the test, the floor of the airframe test section was leveled with ballast and then the aircraft was raised to the desired height (11.2 feet). The total airplane weight was 5200 pounds for the first drop test and 7200 pounds for the second test. The aircraft center of gravity was located at 56.52 inches aft of the nose. The airframe vertical velocity upon impact was approximately 26.0 ft/s.

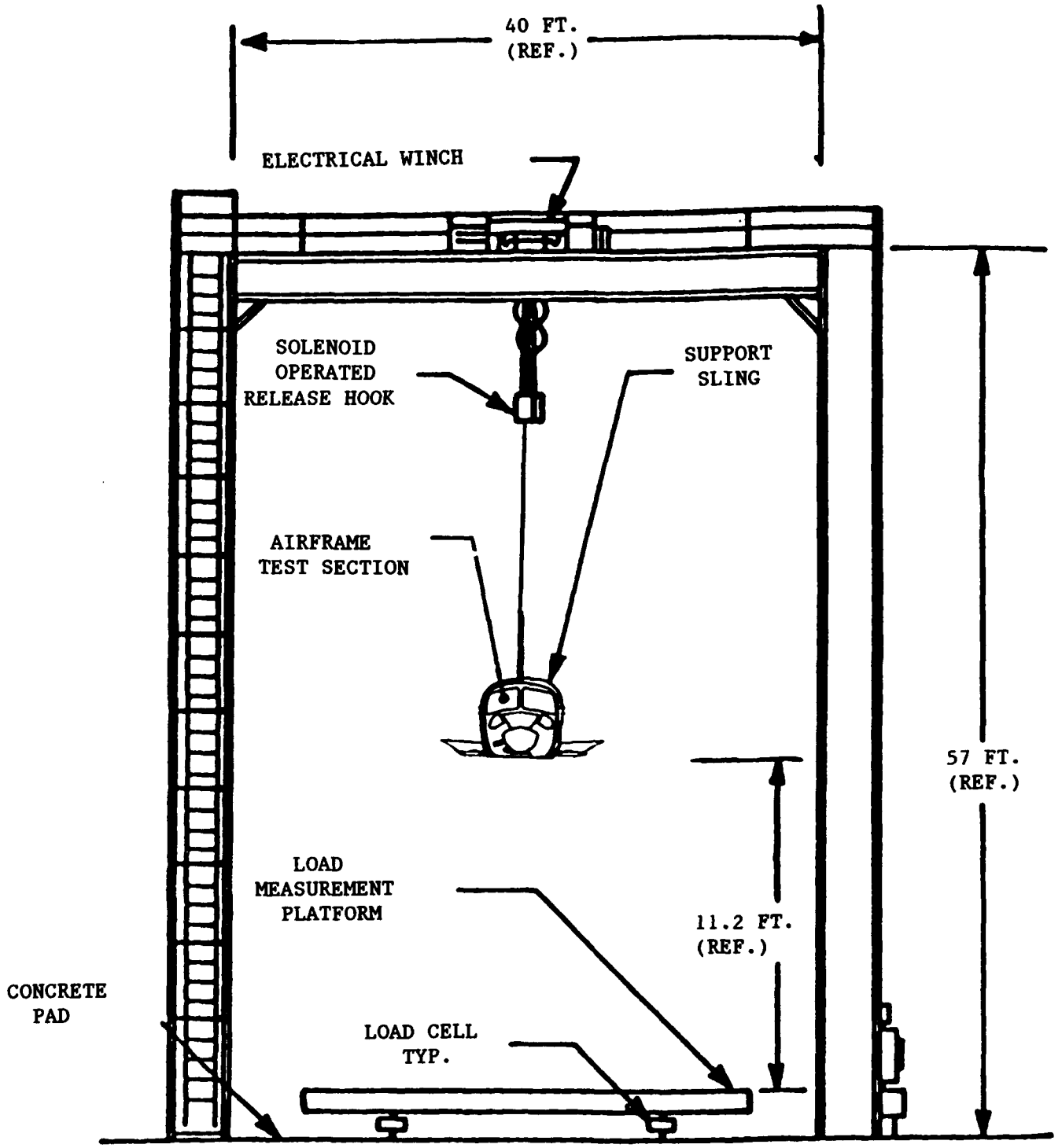


FIGURE 1. DROP TEST FACILITY

TEST ARTICLE.

The test article was a Cessna Model 421B. The airplane is an all metal, low wing aircraft built by Cessna Aircraft Company of Wichita, Kansas.

The specifications of the Cessna Model 421B (figure 2) are as follows:

	MANUFACTURER TYPE CERTIFICATE	TEST CONFIGURATION
Wing span	41.9 ft	26.5 ft
Length overall	36.0 ft	36.0 ft
Height overall	11.5 ft	5.0 ft
Wing area	215 ft	N/A
Maximum takeoff weight	7450 lbs	N/A
Weight empty	5000 lbs	N/A
Max. landing weight	7200 lbs	5200/7200 lbs
Engine weight	500 lbs each	N/A
Center of gravity at fuselage station 152.6 to 157.8 inches		156.52 inches

The Cessna airplane was modified in the following manner:

Each wing was shortened by 7 feet to accommodate clearance between the drop tower legs.

The engines were removed and replaced with steel barrels filled with concrete equivalent in weight and in center of gravity location.

Interior cabin lining was removed so that instrumentation and sensors could be installed.

A distributed mass was added to the top of each wing surface to simulate the fuel and removed wing tip mass.

The fuel cells in the nacelles were replaced with simulated masses.

The landing gear was fully retracted.

One hundred and fifty (150) pounds was added to the tail to account for missing vertical and horizontal stabilizers.

Baggage mass was placed in the baggage compartments to meet the desired aircraft weight and balance configuration.

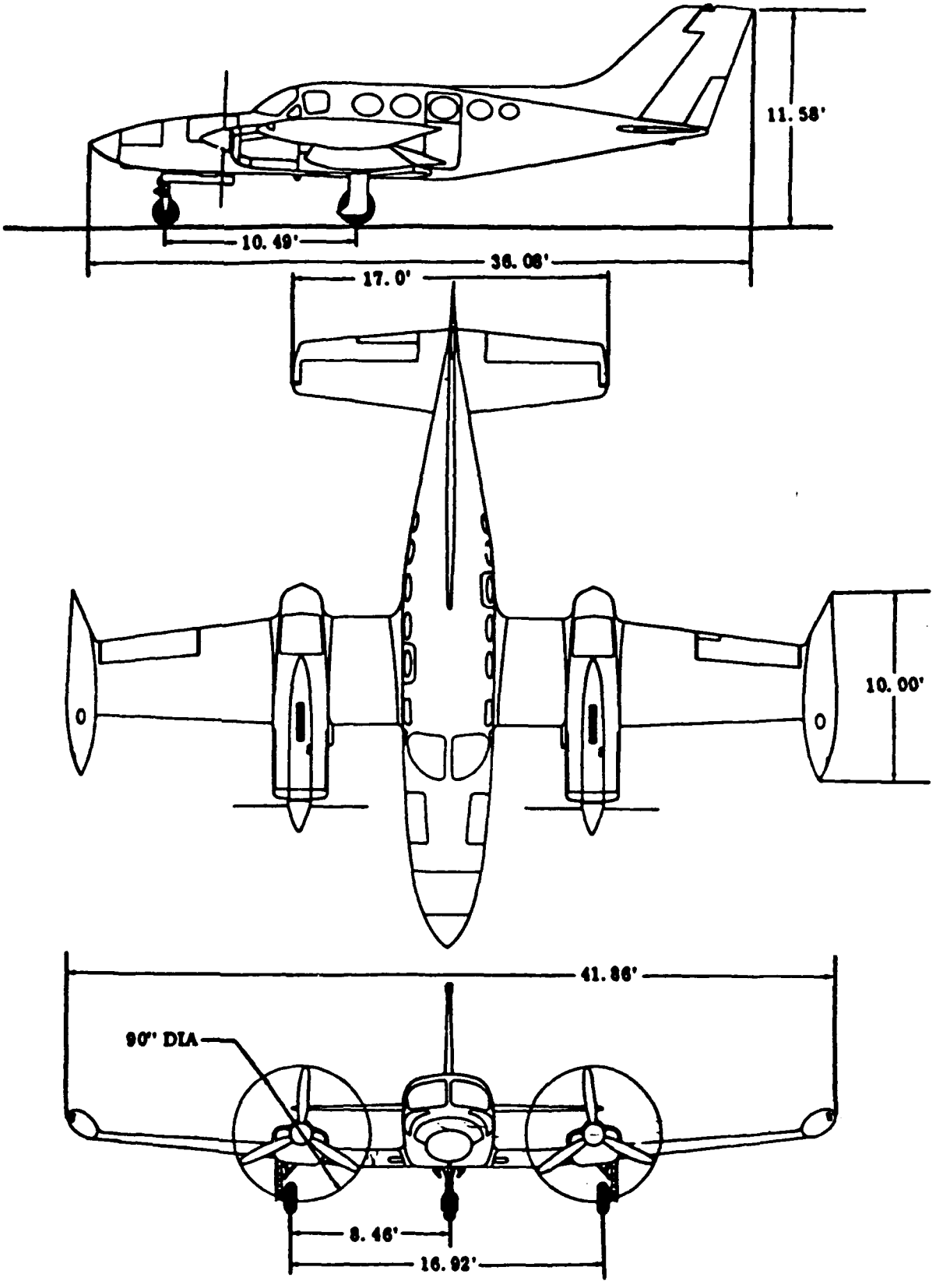


FIGURE 2. CESSNA 421B

The interior airplane cabin was configured to replicate a five-seat occupancy (figure 3) as follows:

For the first test, a standard pilot seat occupied by an anthropomorphic dummy was used to simulate the pilot. However, after the first drop, the pilot seat pedestal suffered significant damage and was unable to be used for the second test. Therefore, the second test was performed with a 200-pound mass placed on the pilot seat's pedestal in lieu of the actual seat and test dummy at fuselage station (FS) 140.

A standard copilot seat occupied by an anthropomorphic dummy was positioned normally for both tests.

Two passenger seats with fully instrumented anthropomorphic dummies were located in the first passenger row at FS 175.5. (The seat on the left (pilot) side of the cabin was an energy absorbing type fabricated by the FAA Civil Aeromedical Institute (CAMI) while the seat on the right was a typical commuter configuration).

The second row of passenger seats and occupants was simulated by a restrained 200-pound mass at each position (FS 215-218); and a single seat with anthropomorphic dummy was located in the rear of the cabin (FS 250) on the left side for test one and the right side for test two.

Figure 4 illustrates the fuselage station configuration of the test aircraft.

Five anthropomorphic dummies were used in the first test, while four were used in the second test. There was a dummy in the copilot seat, and two dummies were in the first row of passenger seats. These latter two anthropomorphic dummies were Hybrid II FAR Part 572 dummies which are instrumented to measure pelvic load and vertical accelerations. Another dummy was seated in the rear seat. A fifth dummy was used in the first test at the pilot location. This was not used in the second test, since the seat pedestal was crushed in the first test. Vertical accelerations only were measured in the pilot, copilot, and rear seat dummies.

INSTRUMENTATION

The interior fabric of the Cessna Model 421B was removed to facilitate instrumentation and sensors installation. The instrumentation was concentrated at FS 154.5, 212.87, and 289.94. The Cessna had 10 accelerometers mounted on the aircraft structure. At FS 154.5 and 212.87 two accelerometers were mounted on each side wall at approximately 6 and 24 inches above the floor. At FS 289.94 there was only one accelerometer mounted above the floor due to space limitations. At FS locations 154.5 and 212.87 there was one accelerometer mounted on the fuselage floor between the two tracks of each seat. At FS 289.94 there were two accelerometers located behind the rear seat which was on top of a raised platform. Table 1 and figure 4 show the coordinates of the instrumentation layout of all sensors used in this test.

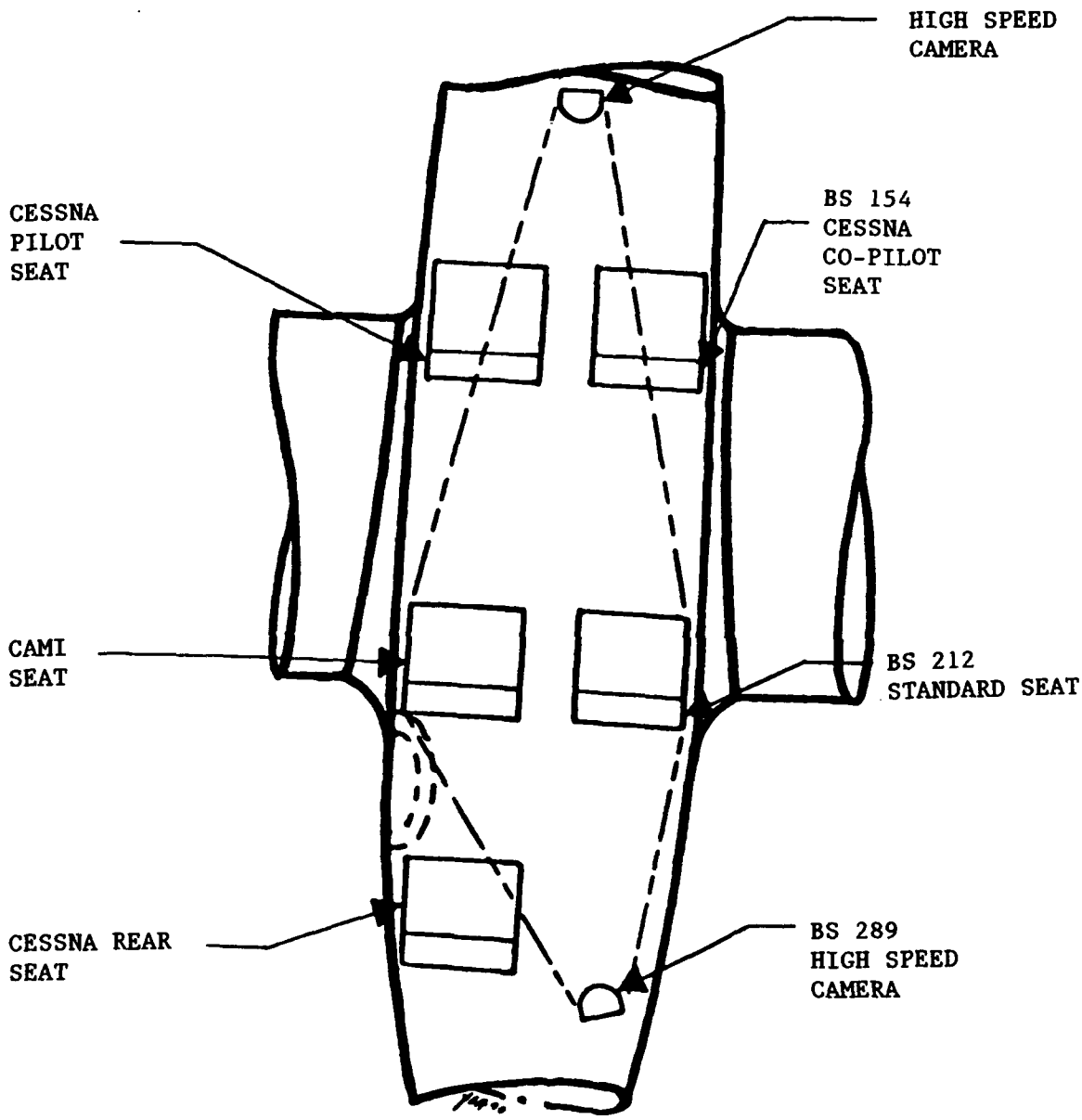


FIGURE 3. AIRCRAFT INTERIOR LAYOUT

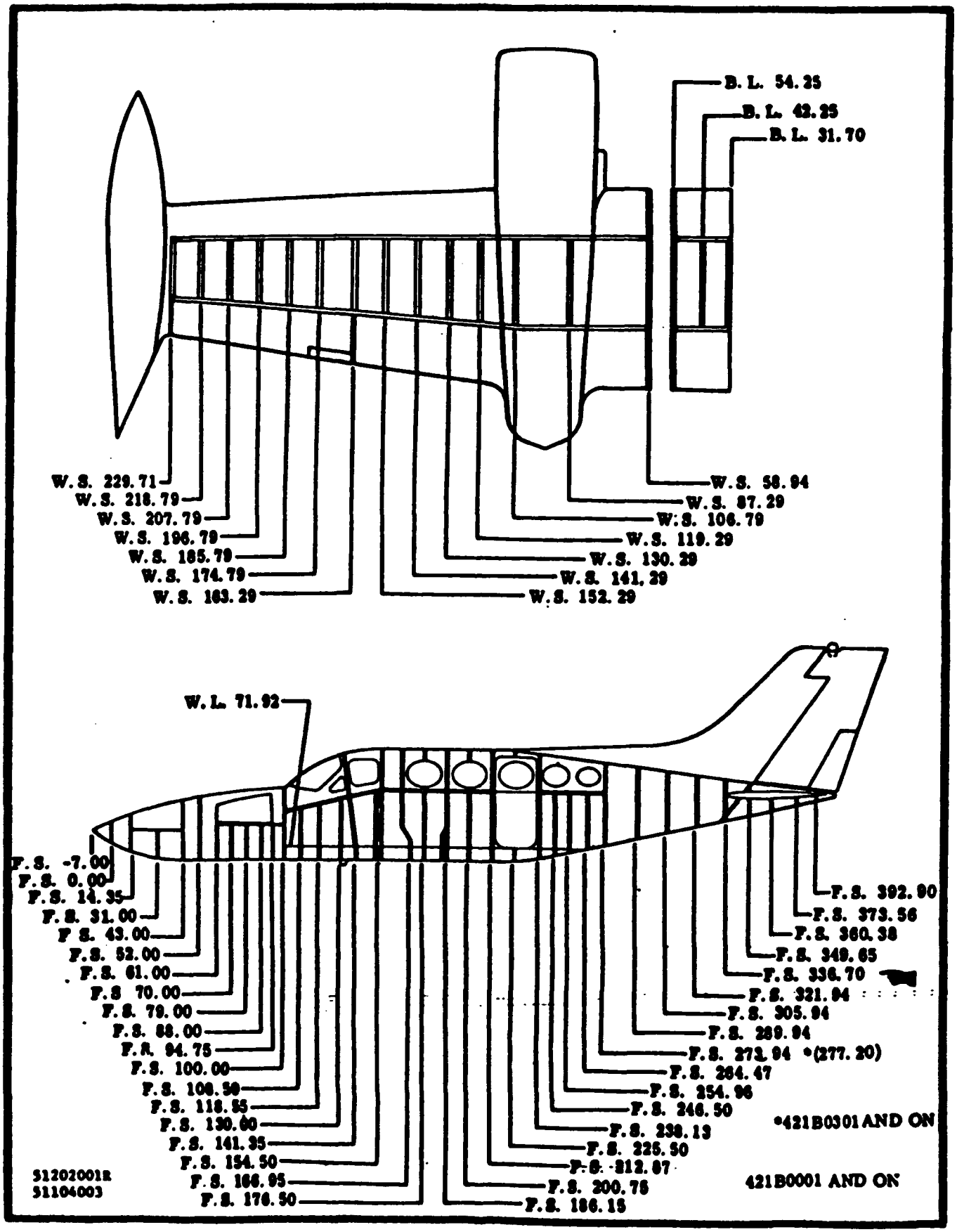


FIGURE 4. FUSELAGE STATION CONFIGURATION

TABLE 1A. X, Y, Z COORDINATES OF ACCELEROMETERS ON CESSNA 421 (TEST 1)

Channel Num/Code	Accelerometer Serial #	Buttock Line (y)	Fuselage Station (x)	**Dimension above floor(z)
1 AV G1	AA 76	-27	154.5	28
2 AV G2	DE 95	-28	154.5	10
3 AV G3	DA 74	-22 1/2	154.5	1 1/2
4 AV G4	CX 08	22 1/2	154.5	1 1/2
5 AV G5	DA 11	28	154.5	10
6 AV G6	CV 29	27	154.5	28
7 *BV G1	CY 92	-28	212.87	28
8 *BV G2	AA 25	-29	212.87	8 1/2
9 *BV G3	AA 87	-14	212.87	0
10 *BV G4	AA 79	14	212.87	0
11 *BV G5	AA 73	29	212.87	8 1/2
12 *BV G6	CR 31	27 1/2	212.87	28
18 CV G1	AA 49	-20	289.94	11 3/4
CV G2	--	--	--	--
19 CV G3	CA 51	- 5	289.94	0
20 CV G4	DE 39	5	289.94	0
CV G5	--	--	--	--
22 CV G6	AA 44	20	289.94	13
26 COPILOT VG1			140.5	
24 *S. DUM VG1 STD SEAT			175.5	
28 *DUM VG1 CAMI			175.5	
25 PELVIC LC CAMI			175.5	
27 PELVIC LC STD. SEAT			175.5	
30 *CAMI STR. POT. 1			175.5	
31 *CAMI STR. POT. 2			175.5	
13 SK STR. POT. 1			164.5	
14 SK STR. POT. 2			164.5	
15 FL. STR. POT. 1			164.5	
16 FL. STR. POT. 2			164.5	
29 Rear Seat			250.0	

*Redundant Channels/Locations

**Dimensions in this table are referenced to aircraft floor which was set equal to zero.

TABLE 1B. X, Y, Z COORDINATES OF ACCELEROMETERS ON CESSNA 421 (TEST 2)

Channel Num/Code	Accelerometer Serial #	Buttock Line (y)	Fuselage Station (x)	**Dimension above floor(z)
1 AV G1	AA 76	-27	154.5	28
2 AV G2	DE 95	-28	154.5	10
3 AV G3	DA 74	-22 1/2	154.5	1 1/2
4 AV G4	CX 08	22 1/2	154.5	1 1/2
5 AV G5	DA 11	28	154.5	10
6 AV G6	CV 29	27	154.5	28
7 *BV G1	CY 92	-28	212.87	28
8 *BV G2	AA 25	-29	212.87	8 1/2
9 *BV G3	AA 87	-14	212.87	0
10 *BV G4	AA 79	14	212.87	0
11 *BV G5	AA 73	29	212.87	8 1/2
12 *BV G6	CR 31	27 1/2	212.87	28
18 CV G1	AA 49	-20	289.94	11 3/4
CV G2	--	--	--	--
19 CV G3	CA 51	- 5	289.94	0
20 CV G4	DE 39	5	289.94	0
CV G5	--	--	--	--
22 CV G6	AA 44	20	289.94	13
26 COPILOT VG1			140.5	
24 *S. DUM VG1 STD SEAT			175.5	
28 *DUM VG1 CAMI			175.5	
25 PELVIC LC CAMI			175.5	
27 PELVIC LC STD. SEAT			175.5	
30 *CAMI STR. POT. 1			175.5	
31 *CAMI STR. POT. 2			175.5	
13 SK STR. POT. 1			164.5	
14 SK STR. POT. 2			164.5	
15 FL. STR. POT. 1			164.5	
16 FL. STR. POT. 2			164.5	
29 Rear Seat			250.0	

*Redundant Channels/Locations
**Dimensions in this table are referenced to aircraft floor which was set equal to zero.

Four string potentiometers were located at FS 164.5. Two of them were located behind the pilot and copilot seats and attached from the fuselage to the floor panels. The other two were also located behind the pilot and copilot seats and attached from the fuselage to the airframe skin (figure 5). These string potentiometers measured any deflection between the upper end of the bulkhead and floor. Two additional string potentiometers were mounted on the CAMI seat in order to measure its seat pan deflection (figure 6).

The instrumentation complied with SAE J211, Instrumentation for Impact Tests. The data channels were prefiltered with an SAE J211 Channel Class 600 or greater filter. The minimum sampling rate was 5000 samples/second/channel.

The wooden impact platform was supported by 12 load cells. Three groups of 4 load cells were connected to three electrical summing boxes. The output of the summing boxes were fed to a summing/amplifier to record the total forces on the platform. A vertical accelerometer was also placed under the platform (figure 7).

All data were recorded on a Phoenix Data HTMS-3000 Data Acquisition System. Ten redundant channels were also provided as indicated in table 1. These data were recorded on a Honeywell 101 analog tape recorder.

Table 2 gives a summary of the number, location (figure 4), and types of sensors used for this test.

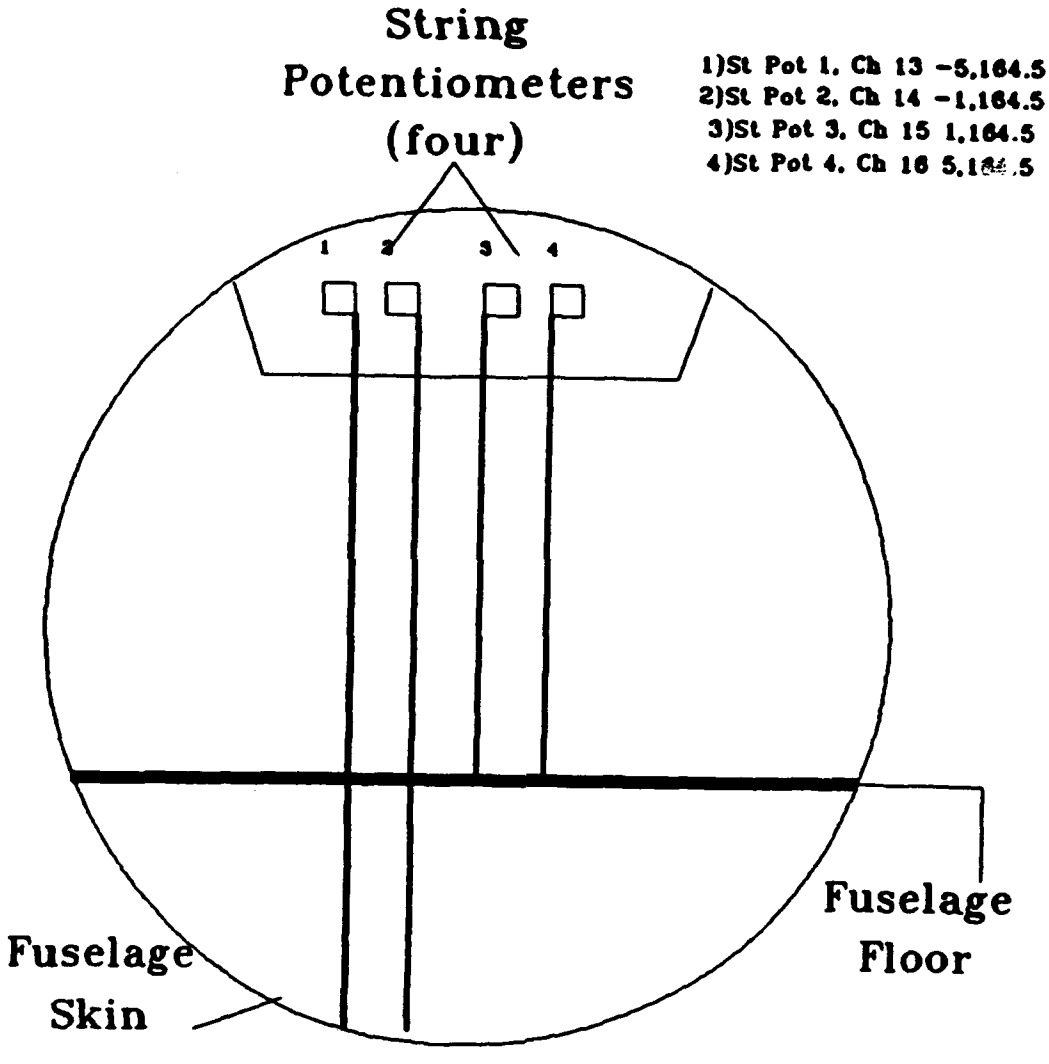


FIGURE 5. POSITIONING OF POTENTIOMETERS

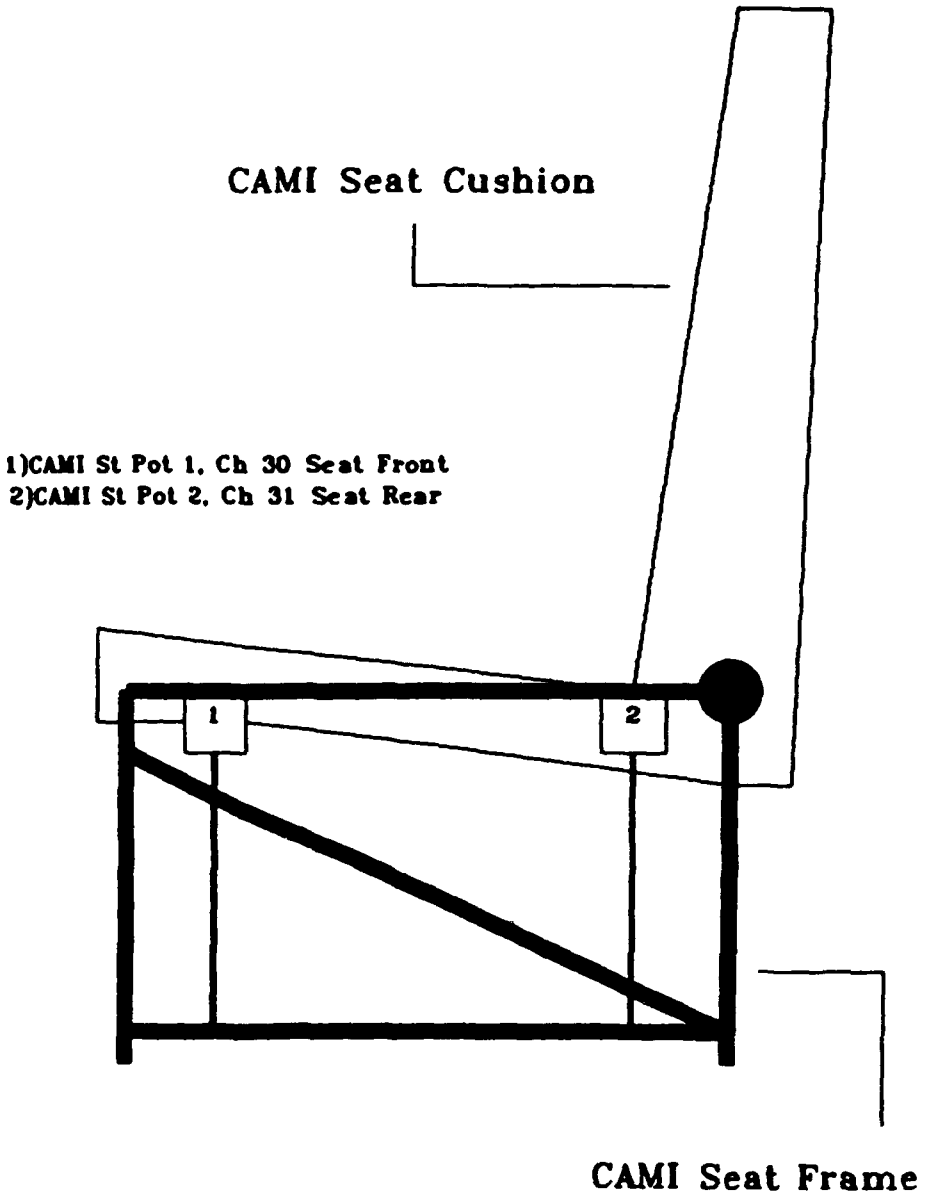


FIGURE 6. POTENTIOMETER ON CAMI SEAT

NOTE: PROPS REMOVED THIS TEST

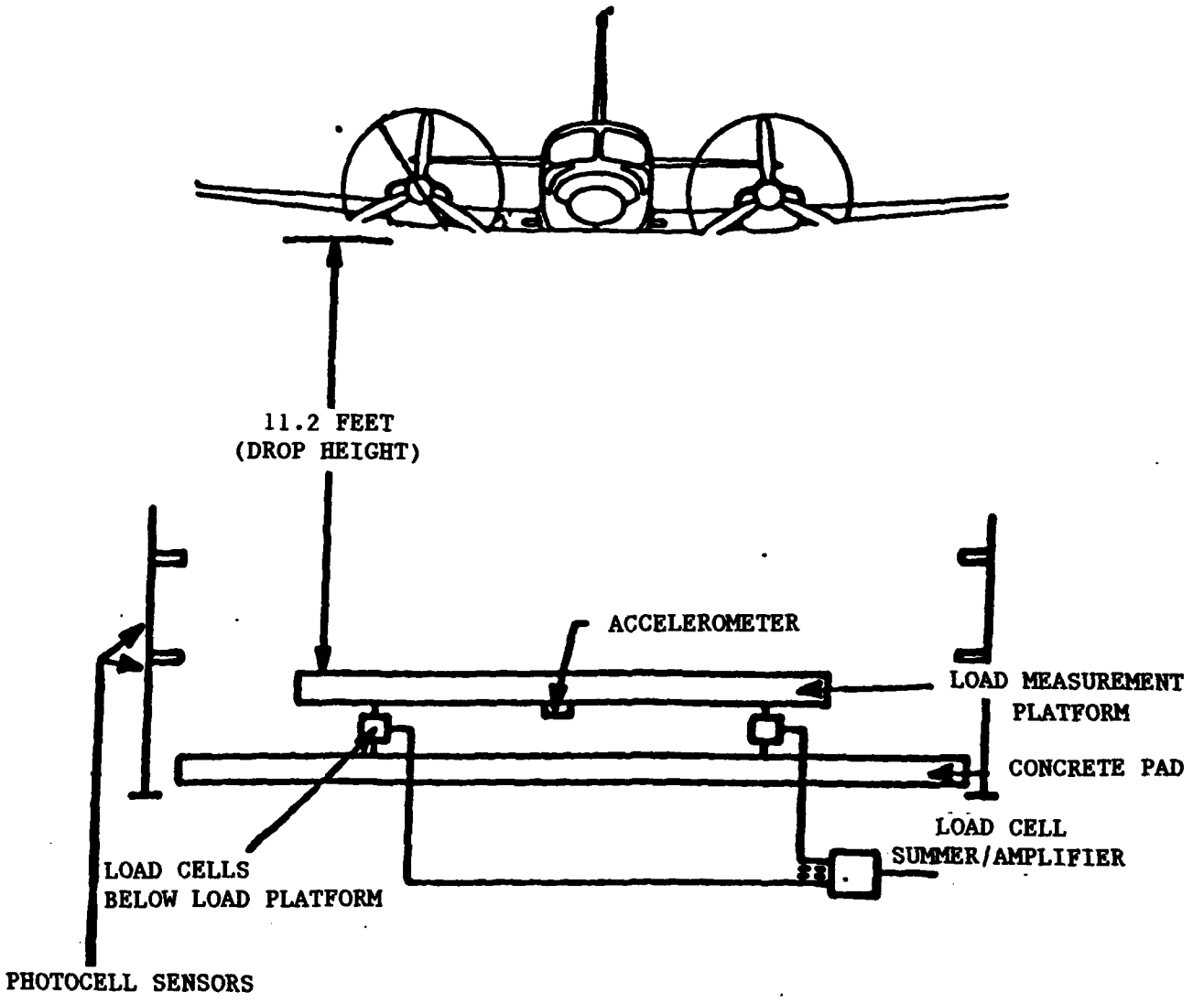


FIGURE 7. TEST ARRANGEMENT

TABLE 2. INSTRUMENTATION LIST

	String Potentiometer	Accelerometers Vert	Lat	Long	Load Cells	Number of Channels
Fuselage	4	12	-	-	-	16
Floor	-	4	-	-	-	4
Platform	-	1	-	-	1	2
Dummy (Pelvis)	-	4/5	-	-	2	6/7
Seat	2	-	-	-	-	2
TOTAL	6	21/22	-	-	3	30/31

Each of these sensors, in addition to two trigger channels, were hardwired into the Phoenix Data HTMS-3000 Data Acquisitions System. A trigger signal at the time of release was used to initiate data acquisition.

DATA ACQUISITION SYSTEM

INSTRUMENTS.

A functional diagram of the data collection instrumentation system is shown in figure 8. Each sensor was initially checked and calibrated with a dedicated signal conditioner. The raw data were then filtered at 1000 cycles per second (Hz), and digitalized, and then sampled at approximately 5,000 samples per second. The data were stored on a Phoenix Data HTMS-3000 Data Acquisition System for a permanent record and for subsequent data reduction. An IBM compatible computer was used for post-test analysis and generation of graphs.

PHOTOGRAPHIC DOCUMENTATION.

High speed (500 ft/s) color film and real-time video coverage were used during the drop test. Three 16 millimeter (mm) high speed cameras viewed the outside of the aircraft. These were front, side, and quarter views. Two similar cameras were placed inside the aircraft; one hung from the cockpit ceiling facing aft, and one in the rear seat area facing forward, viewing the instrumented dummies. The high-speed film coverage was time-synchronized with the data acquisition and control system so the data traces could be directly correlated with the high-speed film. Additionally, 35 mm still photos were taken and are included in this report.

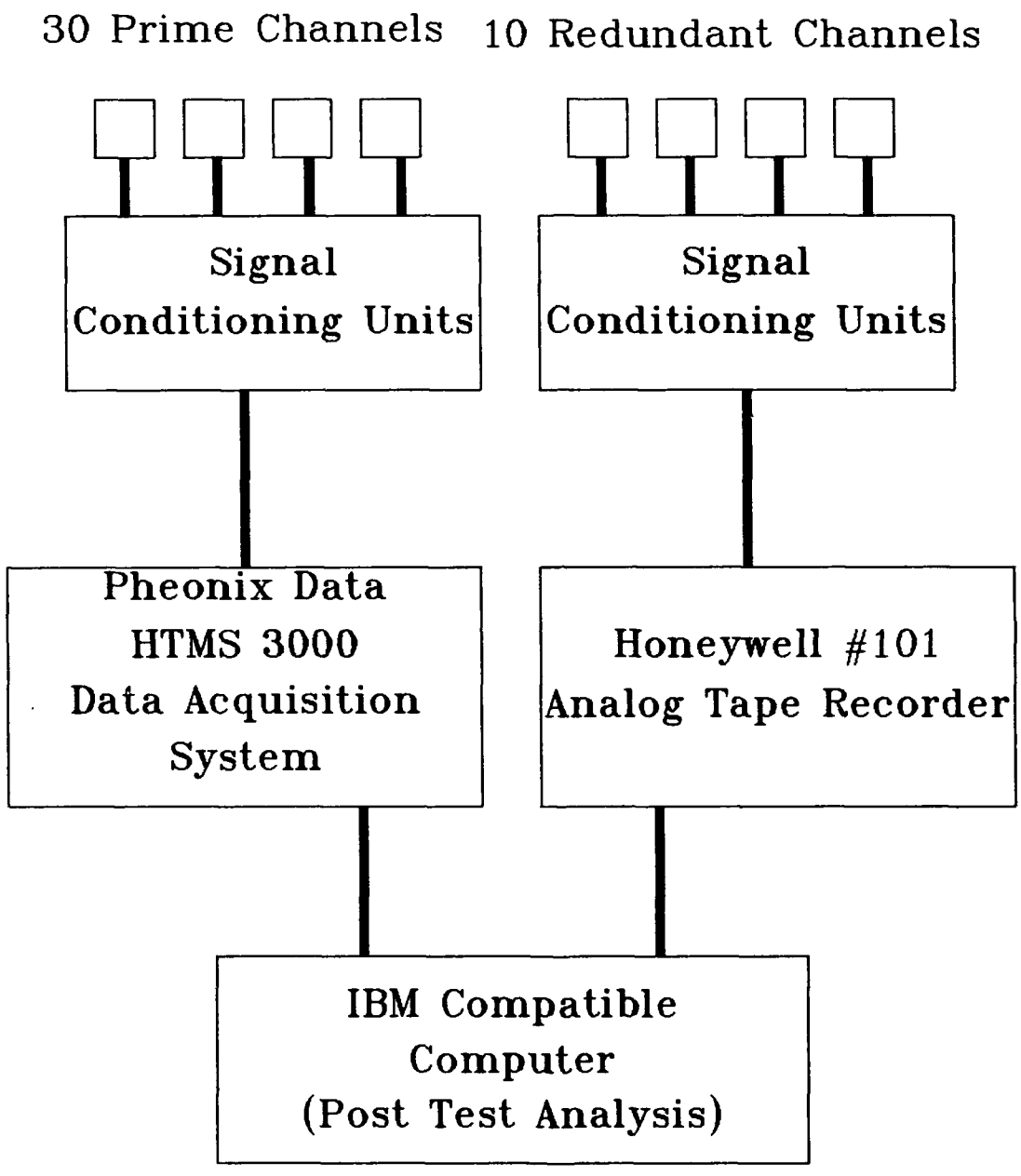


FIGURE 8. INSTRUMENTATION SCHEMATIC

Figure 9 shows the test facility with the test specimen prepared to be lifted. Figure 10 shows the pilot and copilot seats with anthropomorphic dummies prior to the initial drop, while figures 11 and 12 are two views of the CAMI seat prior to the drop. Figures 13 and 14 are views of the standard seat (which was adjacent to the CAMI seat) and the rear seat respectively. Figure 15 shows the aircraft suspended, just before the drop. Figure 16 is a view of the release hook striking the fuselage, causing the unexpected fluctuations in the test data (see total time history plot in appendix C). Figure 17 shows the actual impact of the test specimen with the platform.

The next group of photos were taken after the first test and prior to the second test. Figure 18 is a view of the pilot and copilot seats; notice the shift in the pilot seat caused by impact. Figures 19 and 20 show the pilot and copilot seat stands after impact. The pilot seat was crushed one inch, rendering it useless for the second drop test. Figures 21, 22, 23 provide a number of views of the CAMI seat, revealing the deformation in the CAMI seat pan. The standard seat, next to the CAMI seat, experienced a slight buckling in the legs, which can be seen in figures 24 and 25. Figure 26 provides a view of the rear seat which did not show any significant change. The rigid underside of the Cessna did not experience any significant deformation after the drop, which can be observed in figure 27. However, there was a slight buckling of the fuselage floor behind the right wing (figure 28). Figures 29 and 30, the final pictures from the first drop, illustrate the distance from the fuselage frame to the skin. There was no significant deformation observed at these points.

The next group of photographs are from the second drop test. Figure 31 is a view of the copilot seat preceding the second drop. Figure 32 is of the CAMI seat (on the left) and the standard seat (on the right), before the test. Figure 33 is the rear seat prior to the second drop test. After the test the copilot seat was removed. The seat platform was slightly crushed, which can be seen in figure 34. Figures 35 and 36 provide a more explicit picture of the deformed copilot platform. There was also a slight deformation in the copilot seat (figures 37 and 38). The effectiveness of the CAMI seat, i.e., downward movement of the seat pan, can clearly be seen in figures 39, 40, 41. Conversely, the stiffness of the standard seat is illustrated in figure 42 (no significant deformation). There is also no significant deformation noticeable in the rear seat platform (figure 43). The rigid fuselage of the Cessna is illustrated in figure 44. However, the fuselage crack, aft of the right wing, enlarged during the second test. Figures 45 and 46 clearly show the enlarged split. The distance from the aircraft skin to the airframe was measured after the second drop. There was a slight crush.

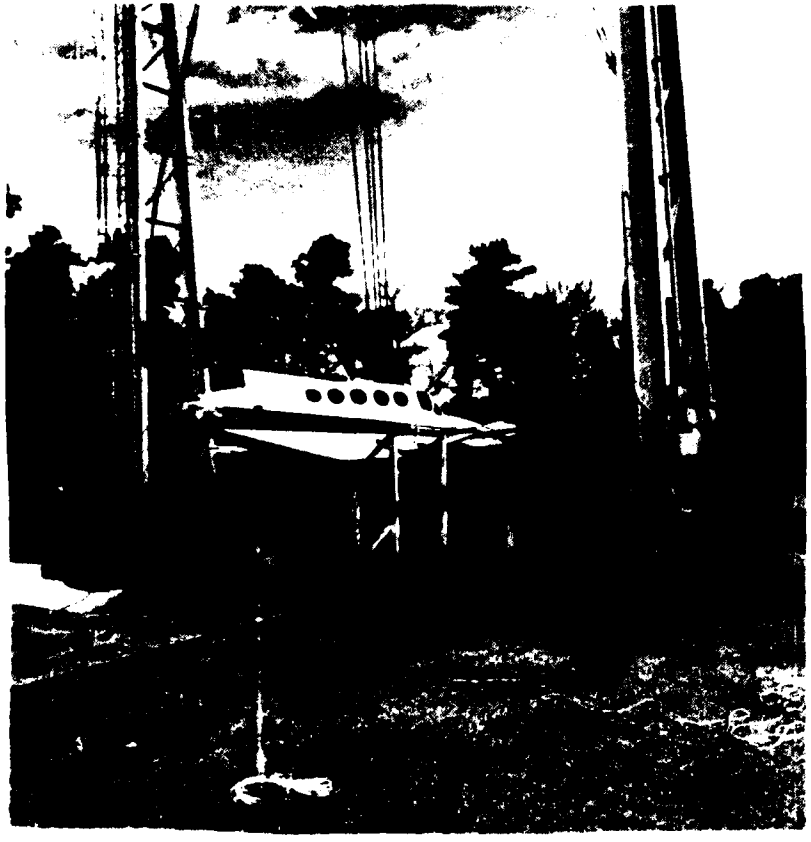


FIGURE 9. TEST FACILITY

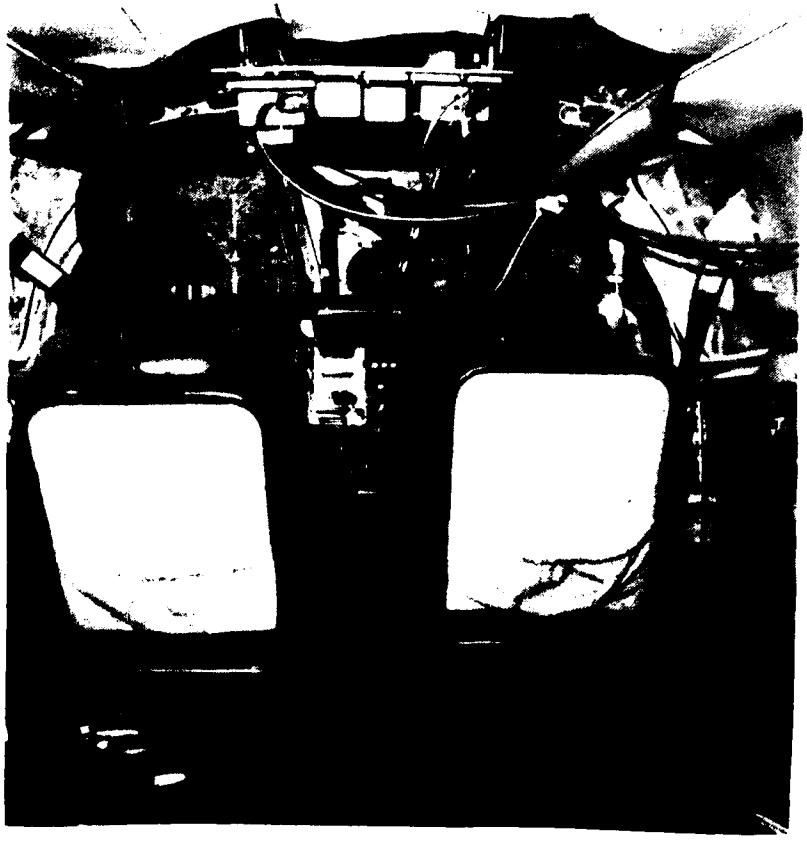


FIGURE 10. PILOT AND COPILOT SEATS

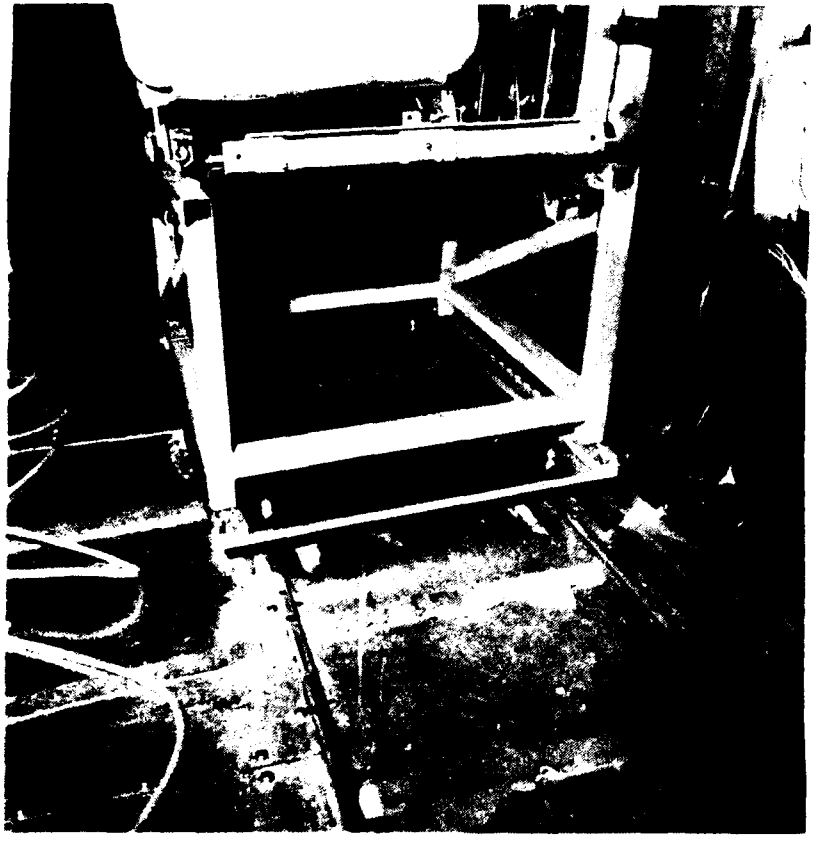


FIGURE 11. CAMI SEAT--FRONT VIEW

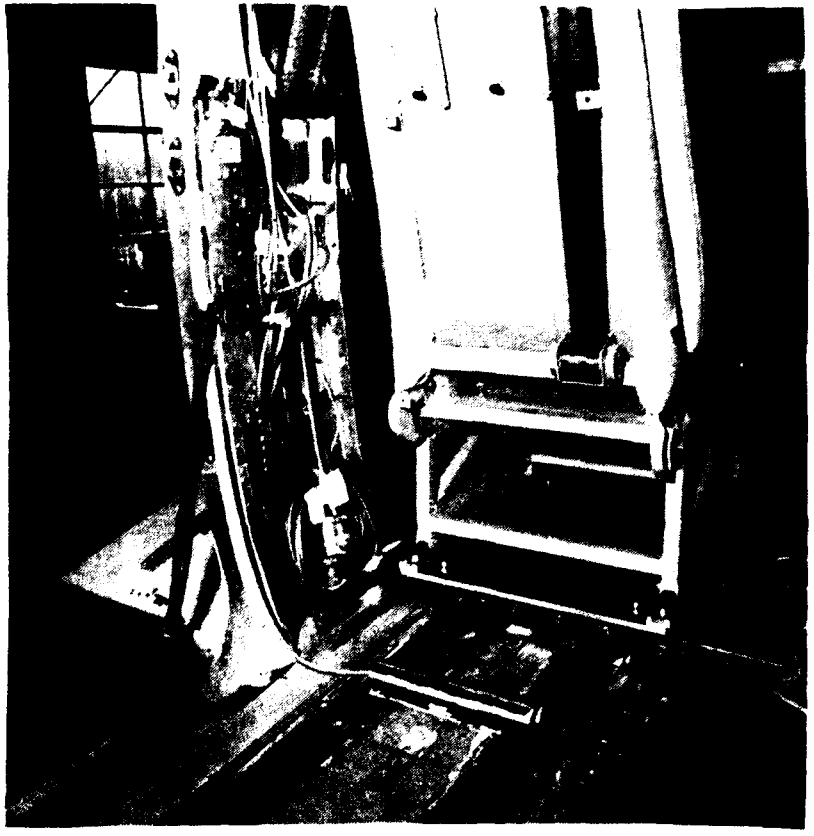


FIGURE 12. CAMI SEAT--REAR VIEW

FIGURE 13. COMMUTER SEAT

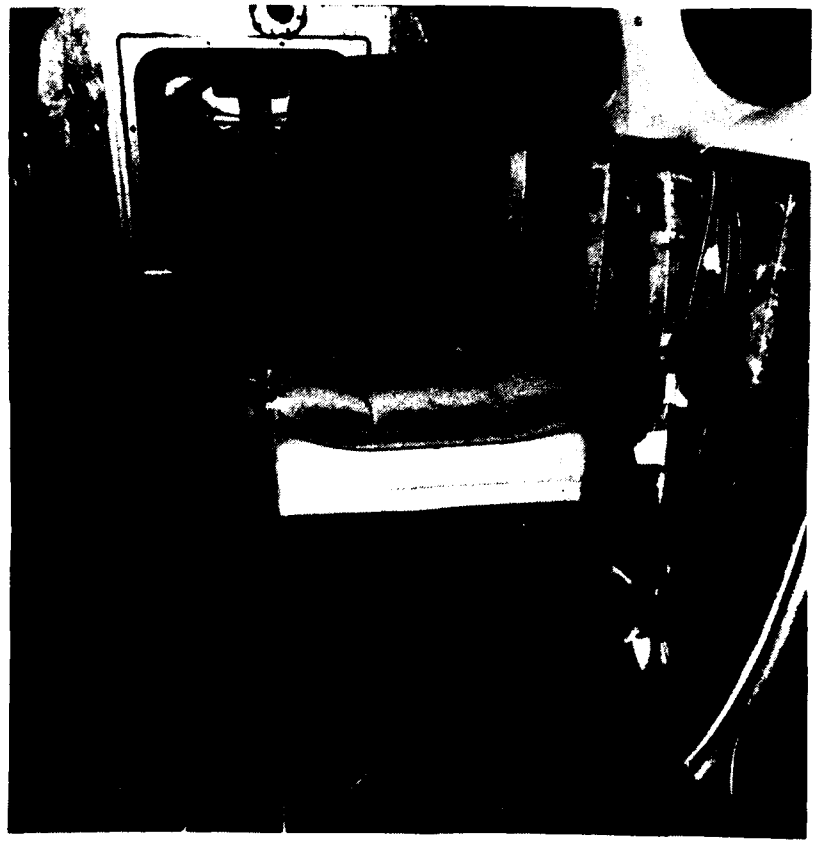


FIGURE 14. REAR SEAT

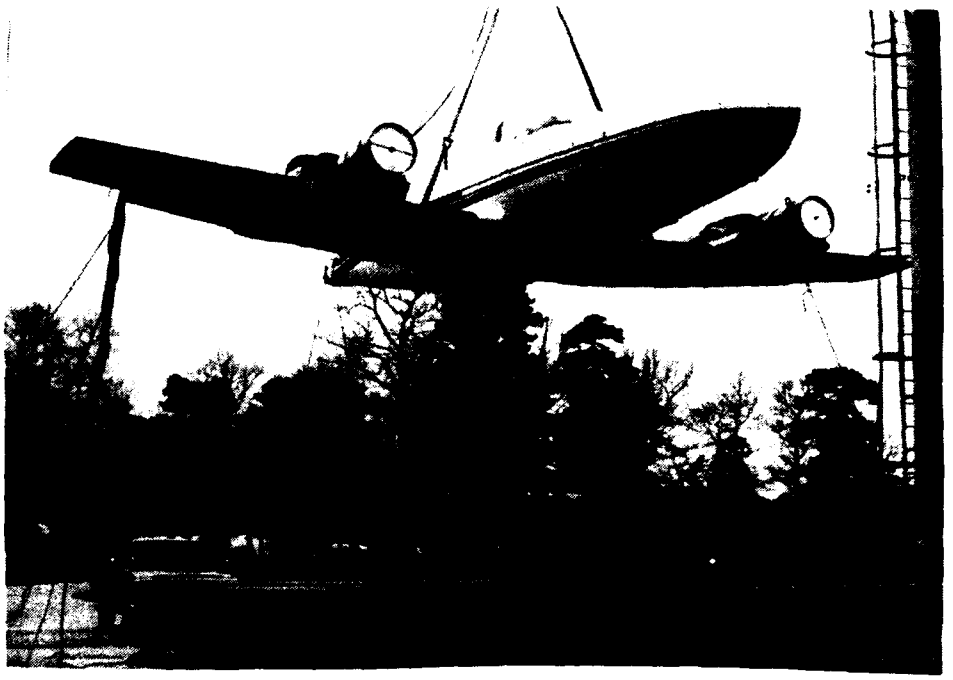


FIGURE 15. HOOK RELEASE

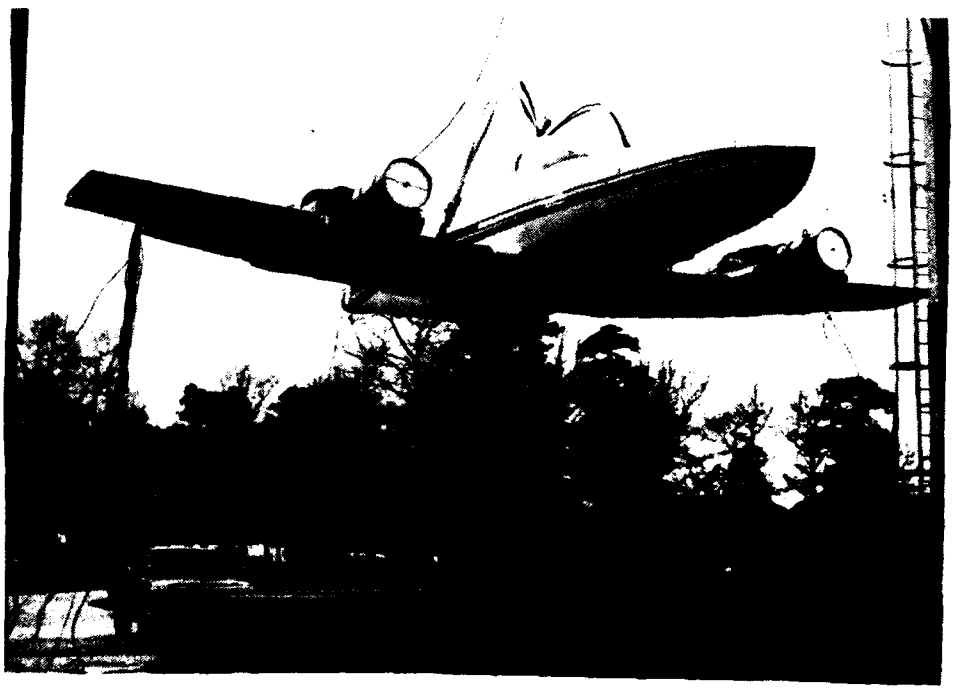


FIGURE 16. HOOK IMPACT WITH AIRCRAFT

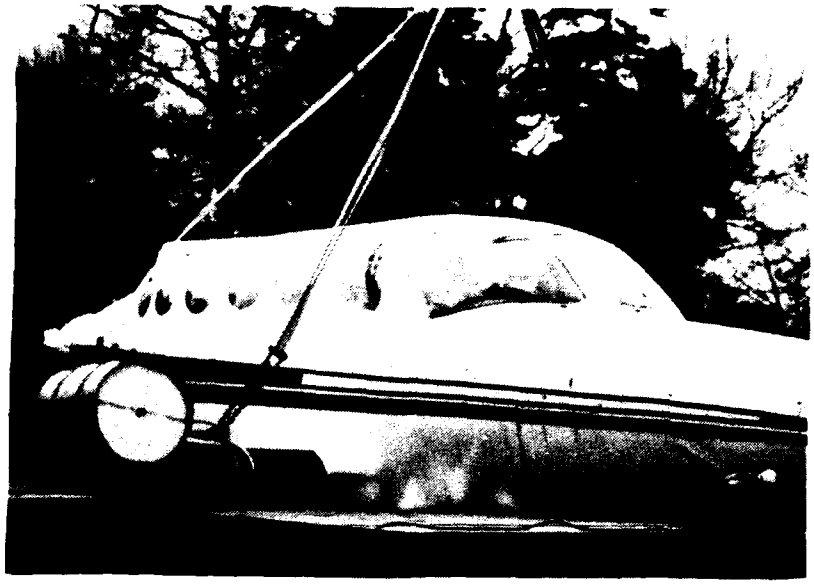


FIGURE 17. AIRCRAFT IMPACT WITH PLATFORM

FIGURE 18. PILOT AND COPILOT SEATS AFTER IMPACT

FIGURE 19. PILOT SEAT STAND AFTER IMPACT

FIGURE 20. COPILOT SEAT AFTER IMPACT

FIGURE 21. CAMI SEAT AFTER IMPACT
REAR VIEW 1

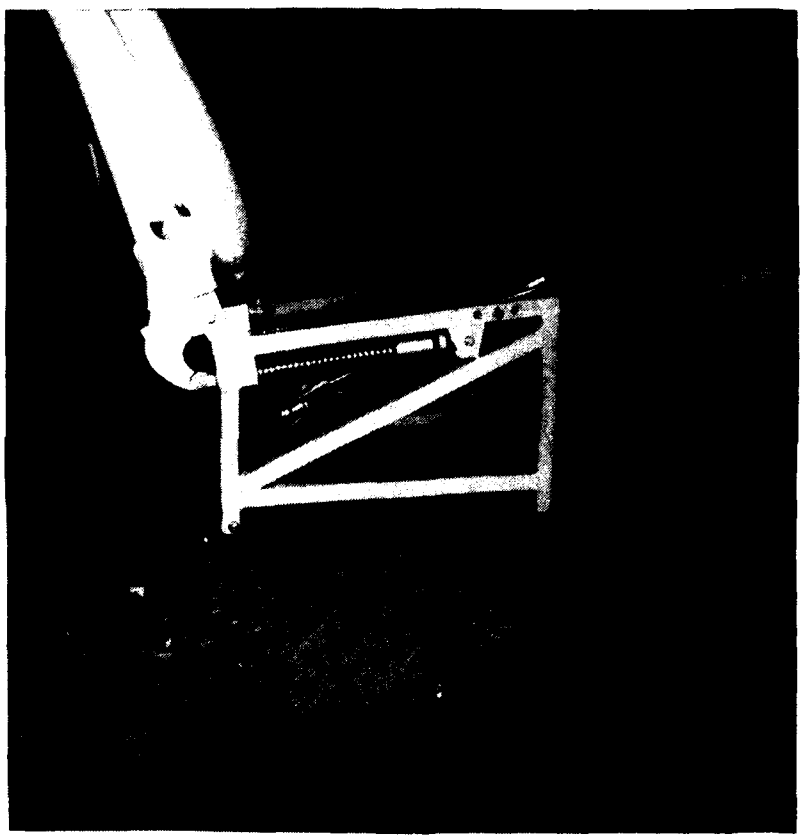


FIGURE 22. CAMI SEAT AFTER IMPACT
SIDE VIEW

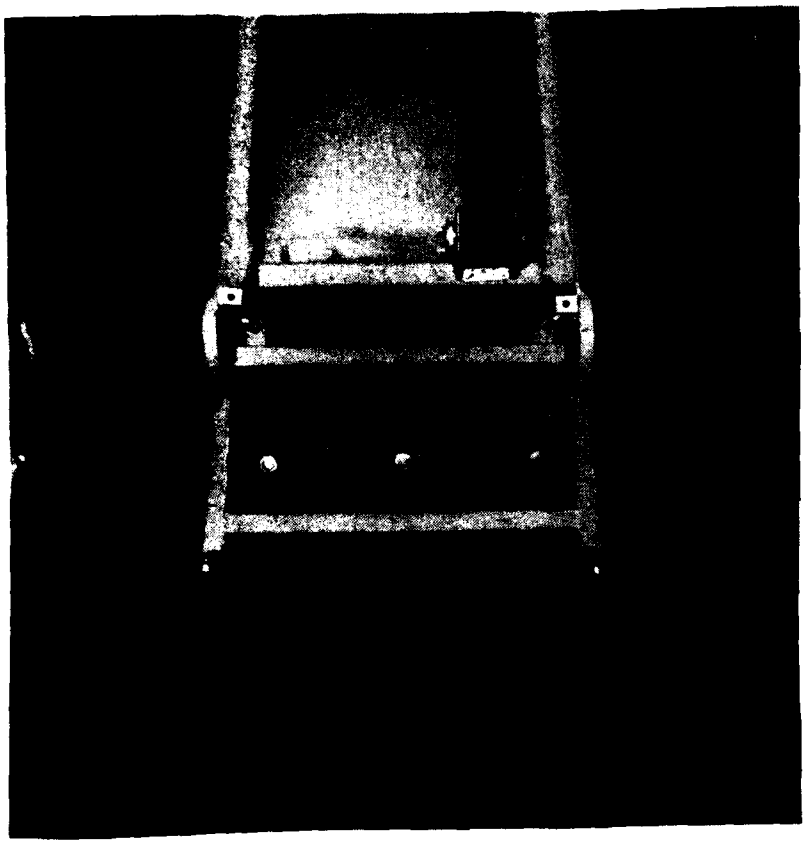


FIGURE 23. CAMI SEAT AFTER IMPACT
REAR VIEW 2

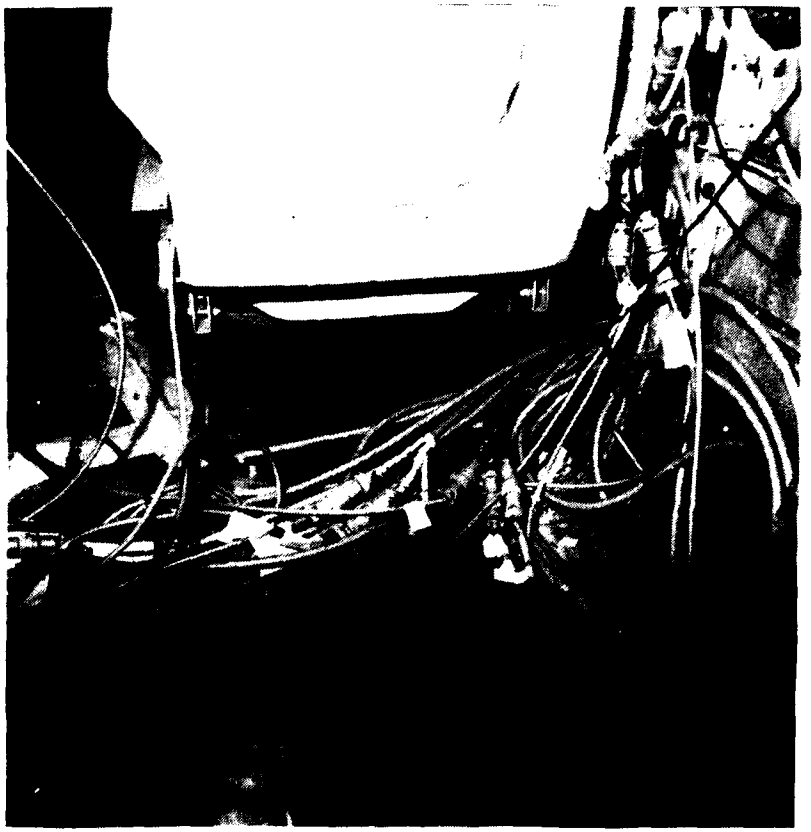


FIGURE 24. COMMUTER SEAT AFTER IMPACT
REAR VIEW

FIGURE 25. COMMUTER SEAT AFTER IMPACT
SIDE VIEW

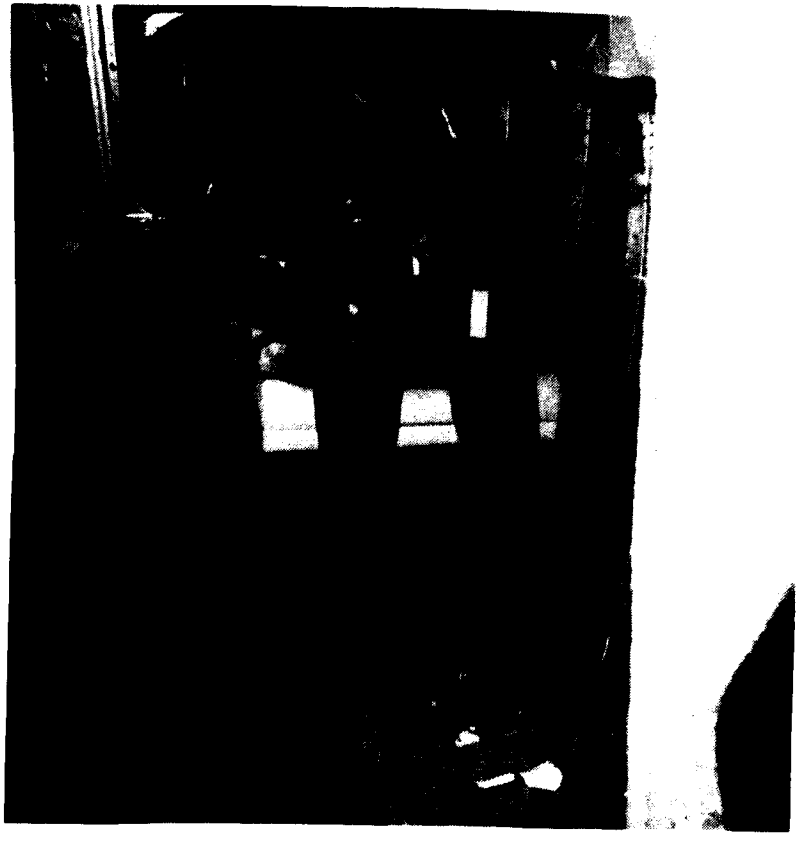


FIGURE 26. REAR SEAT AFTER IMPACT

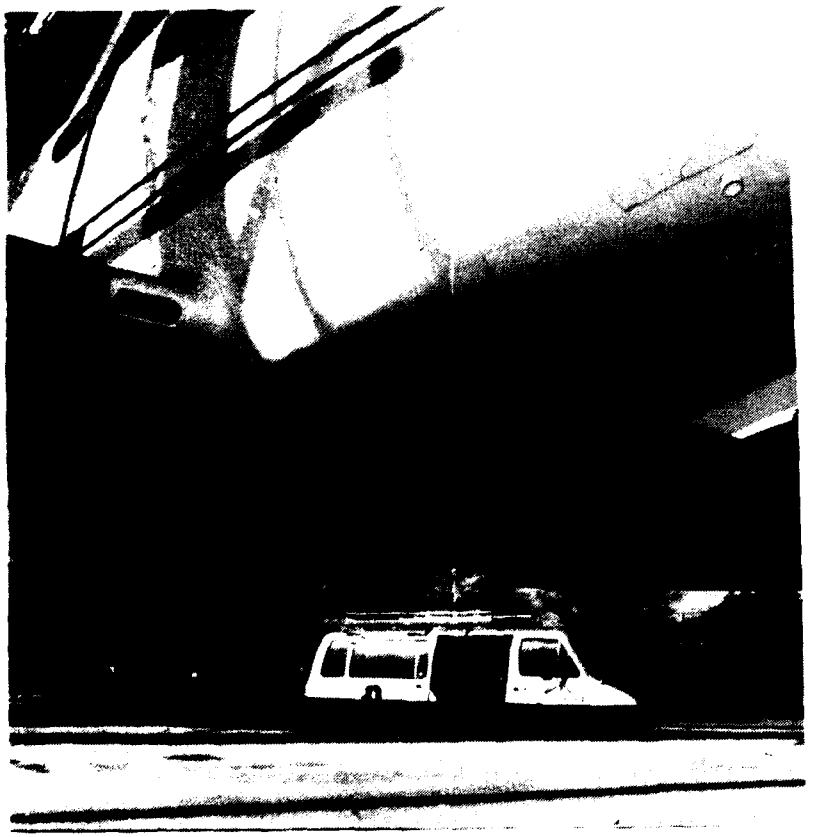


FIGURE 27. UNDERSIDE OF AIRCRAFT AFTER IMPACT

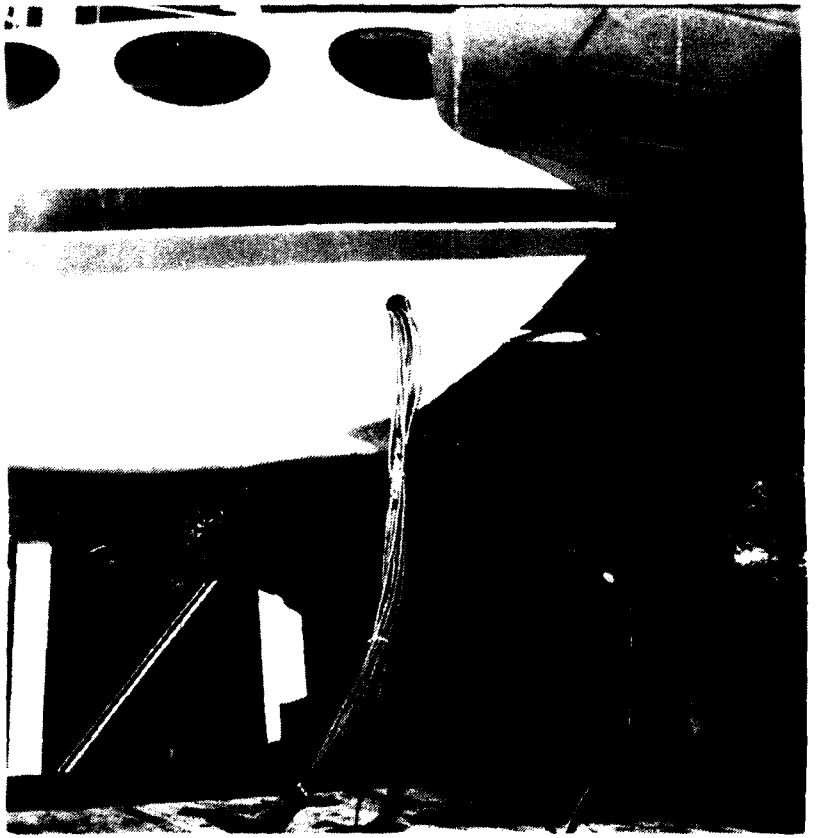


FIGURE 28. RIGHT WING BUCKLING AFTER IMPACT

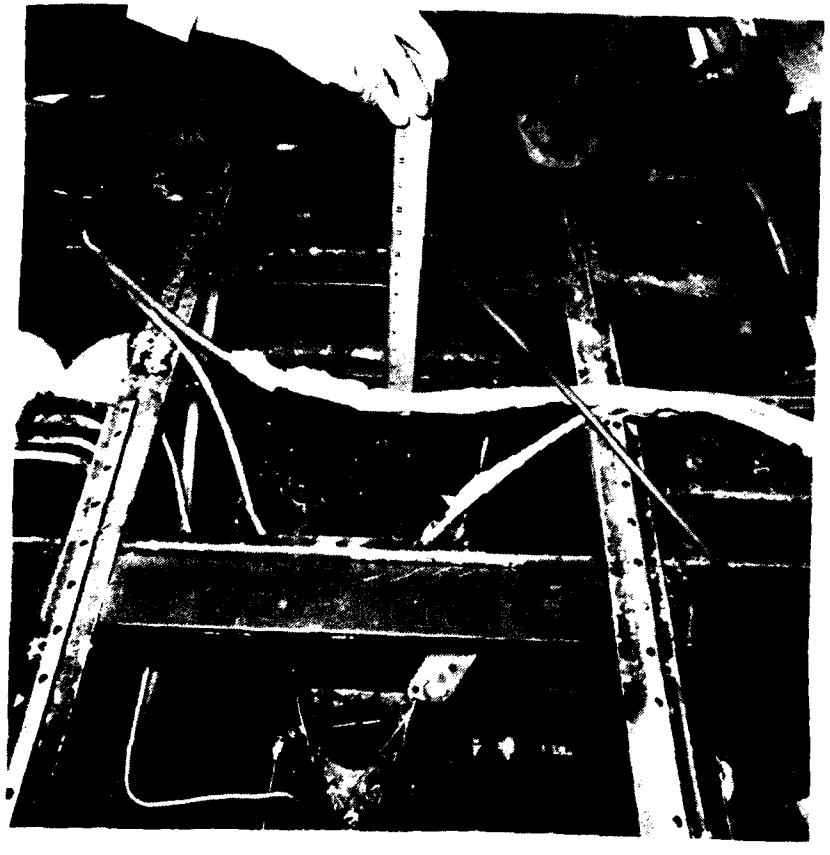


FIGURE 29. DISTANCE FROM SKIN TO FRAME AFTER IMPACT--VIEW 1

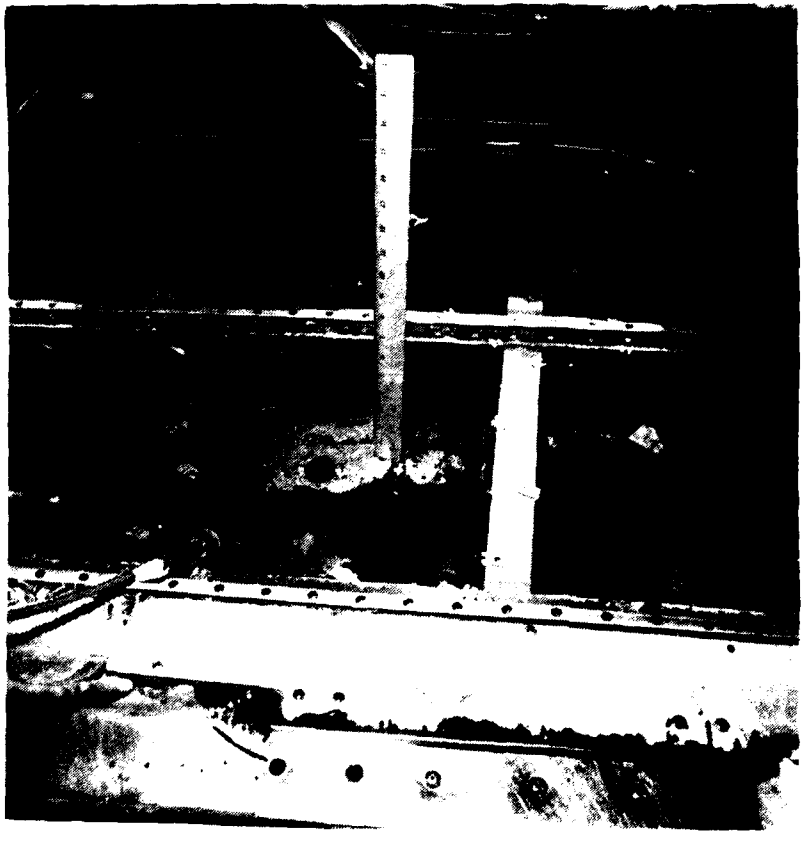


FIGURE 30. DISTANCE FROM SKIN TO FRAME AFTER IMPACT--VIEW 2

FIGURE 31. COPILOT SEAT

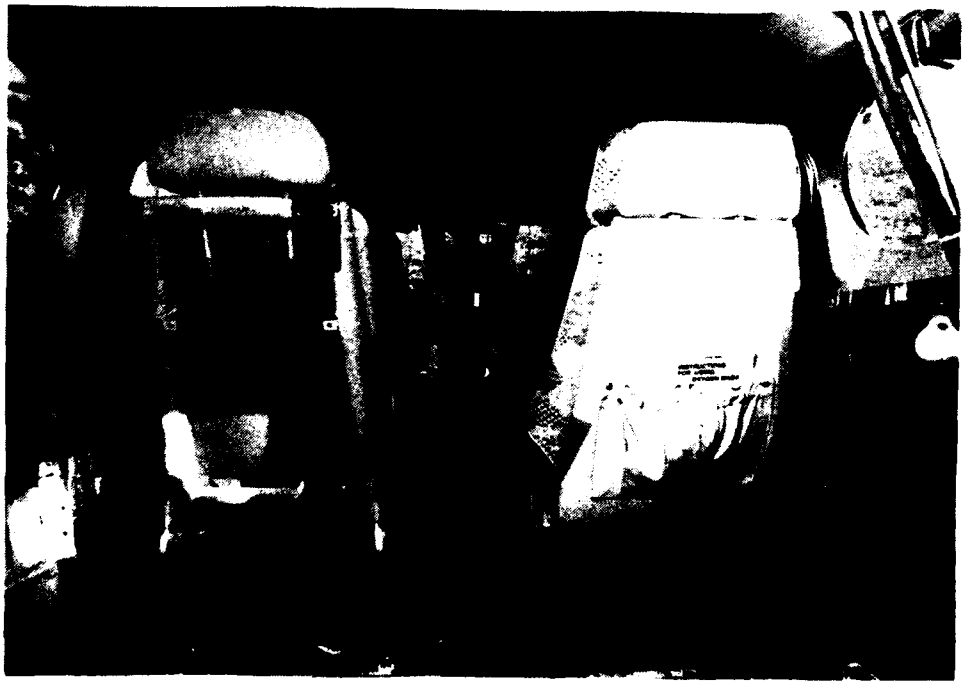


FIGURE 32. CAMI SEAT AND COMMUTER SEAT

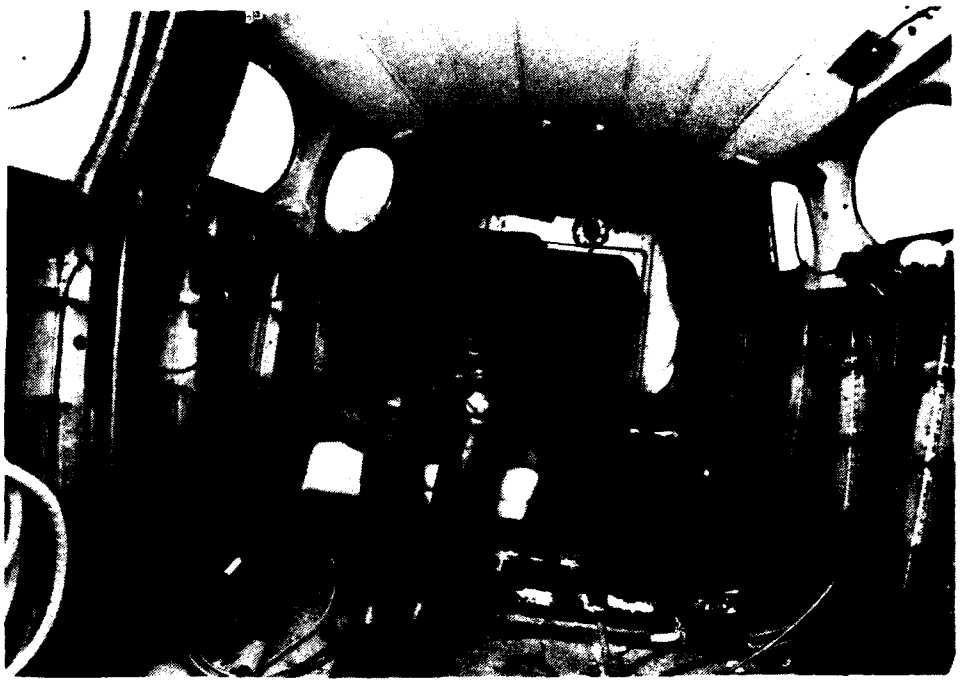


FIGURE 33. REAR SEAT

FIGURE 34. PILOT SEAT AND COPILOT SEATS AFTER IMPACT

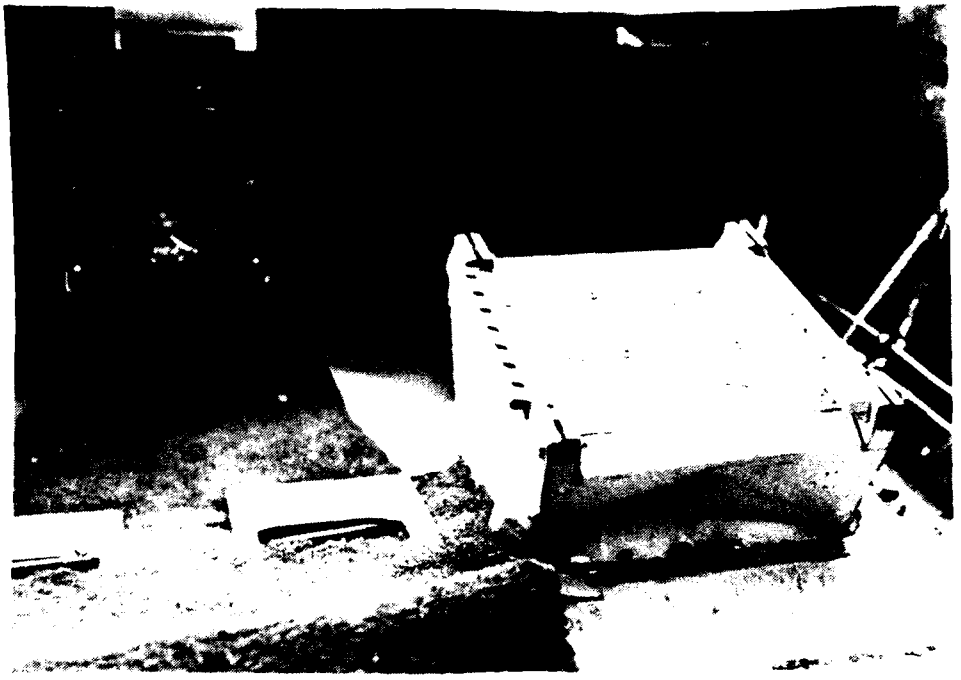


FIGURE 35. COPILOT SEAT PEDESTAL AFTER IMPACT--REAR VIEW

FIGURE 36. COPILOT SEAT PEDESTAL AFTER IMPACT--SIDE VIEW

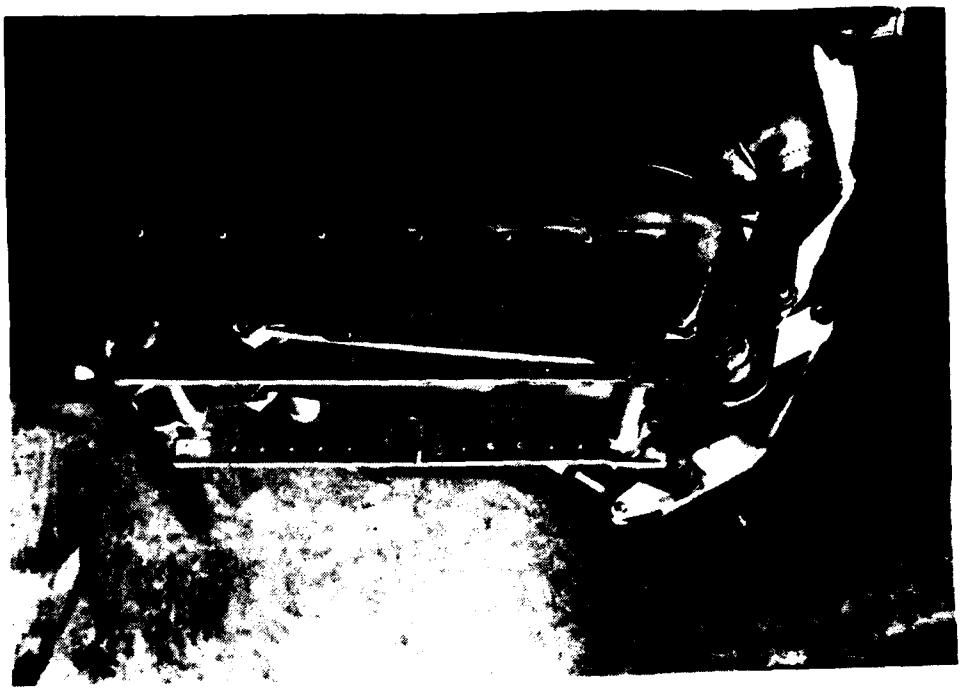


FIGURE 37. COPILOT SEAT AFTER IMPACT--SIDE VIEW

FIGURE 38. COPILOT SEAT AFTER IMPACT--UNDERSIDE

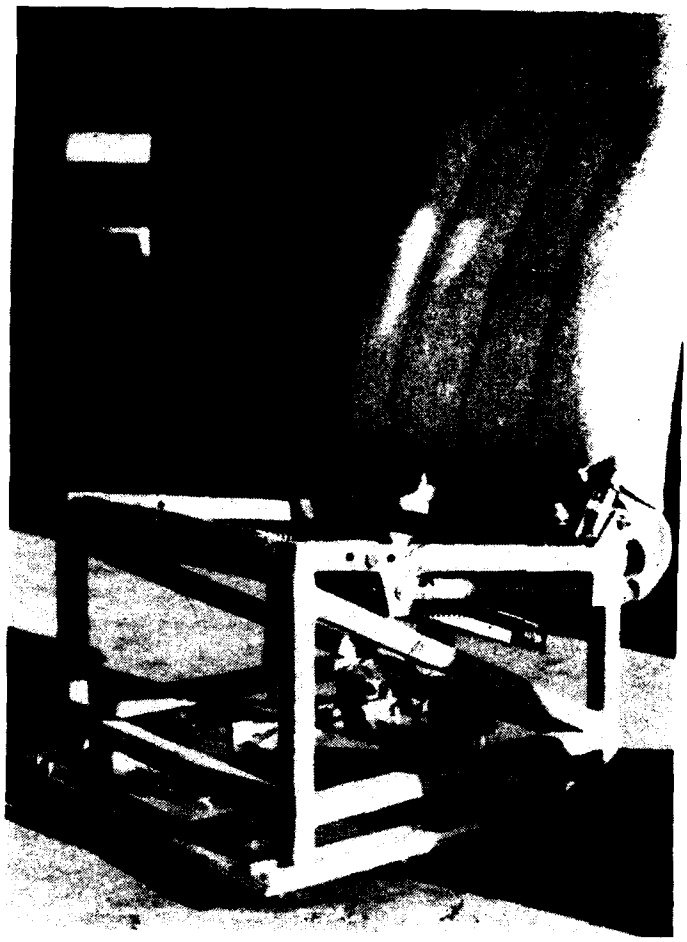


FIGURE 39. CAMI SEAT AFTER IMPACT--SIDE VIEW

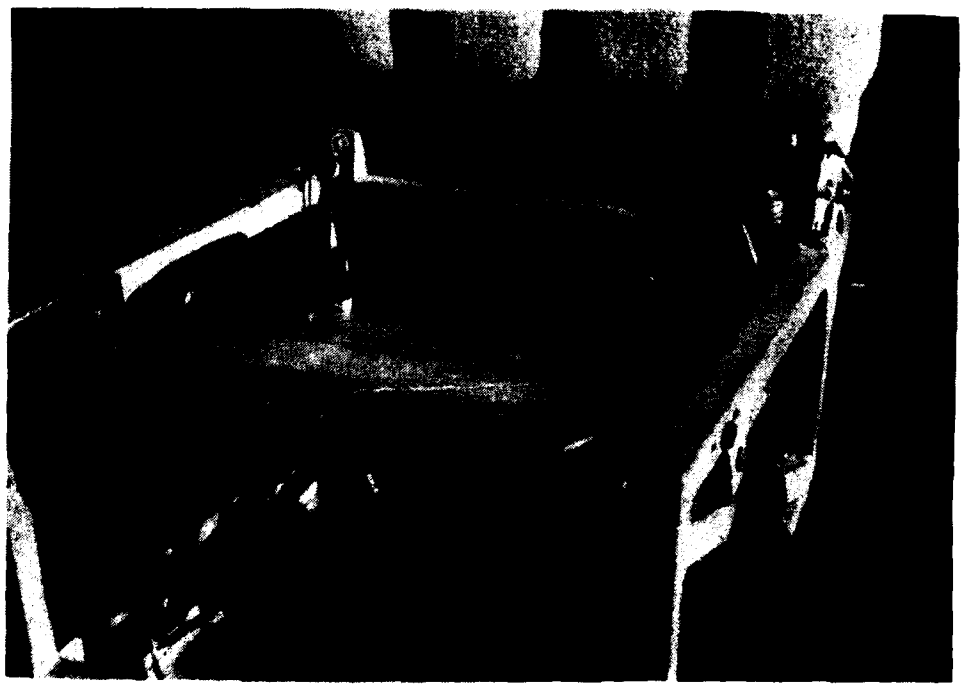


FIGURE 40. CAMI SEAT AFTER IMPACT--FRONT VIEW

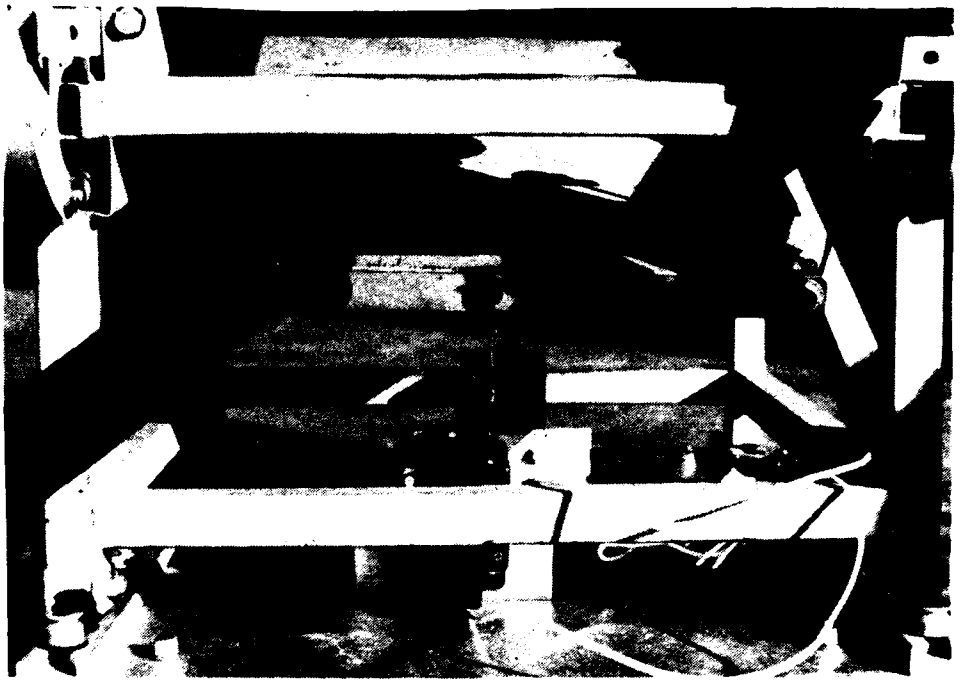


FIGURE 41. CAMI SEAT AFTER IMPACT--UNDERSIDE

FIGURE 42. COMMUTER SEAT AFTER IMPACT

FIGURE 43. REAR SEAT PLATFORM AFTER IMPACT

FIGURE 44. UNDERSIDE OF AIRCRAFT AFTER IMPACT

FIGURE 45. FUSELAGE SKIN BUCKLING AFTER IMPACT

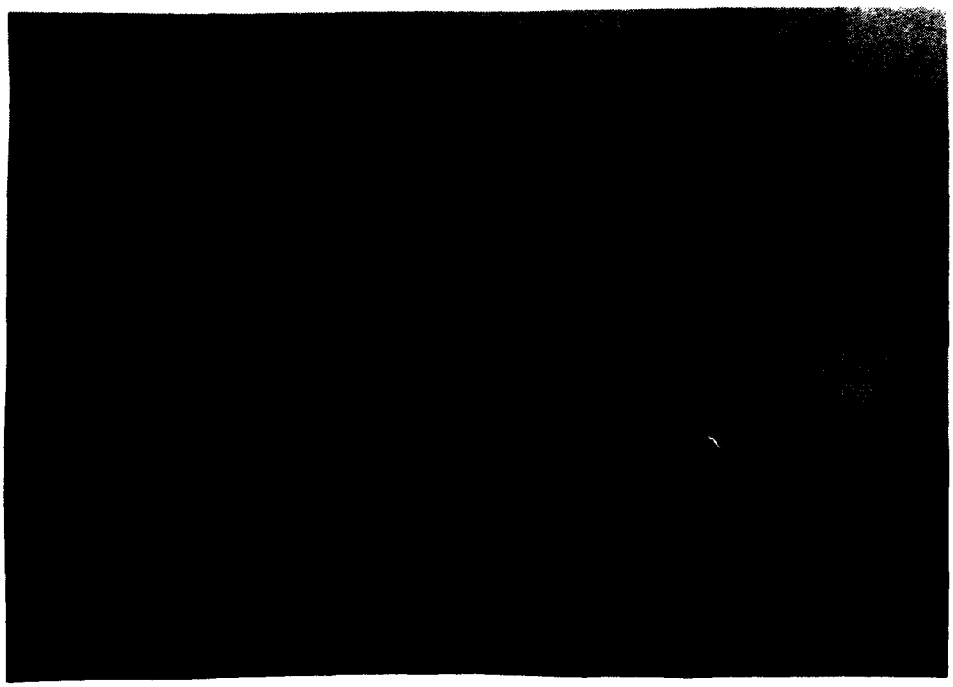


FIGURE 46. FUSELAGE SKIN BUCKLING AFTER IMPACT--CLOSEUP

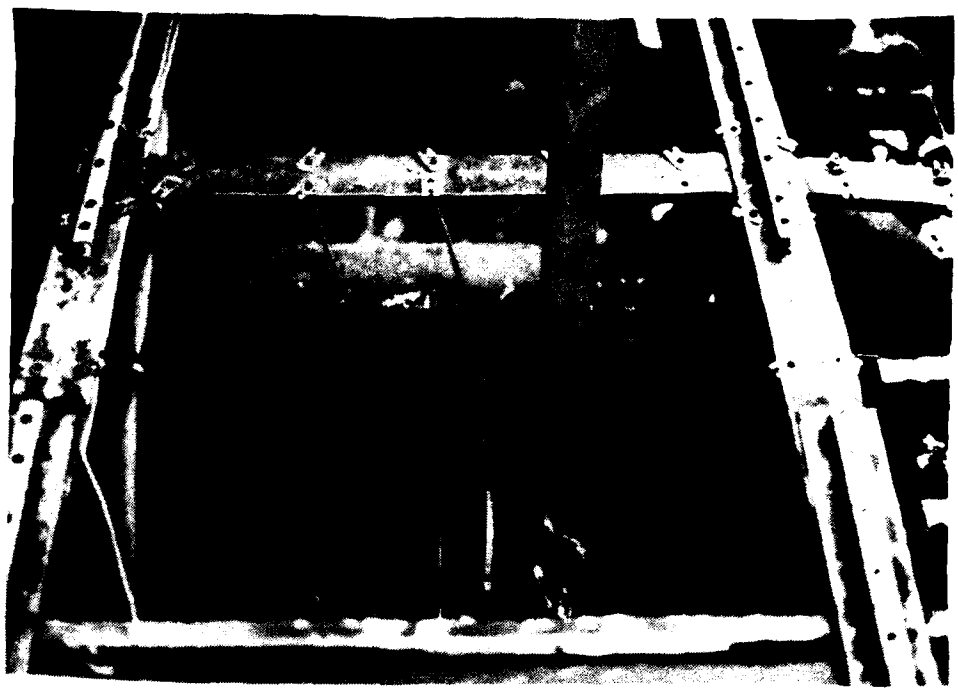


FIGURE 47. DISTANCE FROM SKIN TO FRAME AFTER IMPACT--VIEW 1

FIGURE 48. DISTANCE FROM SKIN TO FRAME AFTER IMPACT--VIEW 2

POST-TEST ANALYSIS PROCEDURE

The recorded data were corrected for zero offset, and the point of impact was identified to be approximately 0.9 seconds after the hook release. The unfiltered digital data were then filtered with an SAE J211 Class 60 filter (or equivalent) for acceleration, displacement, and platform load cell data. A Class 600 filter was used on the dummy lumbar column load cell data. In addition, velocity plots were made by integrating the acceleration data. Plots of the unfiltered and filtered acceleration as well as the velocity can be seen in the appendices. Appendix A contains graphs for test 1, while appendix B contains graphs for test 2. The digitally filtered data were read into data files that included at least 150 milliseconds (ms) of data from the point of impact. Time history data graphs (one for each data channel) were generated using the digital filtered data files. The time history data graphs include a title reflecting the Cessna 421B drop test, the data channel, and the parameters plotted. Overall time history plots are provided from both tests (appendix C). The blocked out area represents the 350 milliseconds of data given in the more detailed plots.

RESULTS

During the first drop test of the Cessna 421B, the left side (pilot side) of the aircraft impacted slightly before the copilot side. Due to the imbalance, the pilot side experienced a 70-g environment upon impact while the copilot side experienced a 40-g environment. During the second test the aircraft was level at impact creating a 50- to 55-g environment for all seats.

The pelvic load measured in the dummy seated in the CAMI seat was 1600 pounds in the first test, and 1200 pounds in the second test. The standard seat experienced higher loads in both the first and second tests of 1700 pounds and 1800 pounds, respectively.

The CAMI seat reduced the load experienced by the passenger by absorbing a portion of the force through seat stroking. The forward part of the seat pan rotated down approximately 3 inches. The limit load for avoiding serious injury on the pelvic region is 1500 pounds. The CAMI seat successfully limited the pelvic load to below 1500 pounds in a 55-g environment.

The Cessna 421B is an extremely rigid airframe structure. This can be observed by the lack of deformation on the bottom of the aircraft after the tests, as well as the insignificant crush distance between the airplane floor and the fuselage skin.

Graphs of the data from the accelerometers, string potentiometers, and load cells for the first drop test appear in appendix A. These graphs include filtered data, unfiltered data, and velocity plots. All graphs contain approximately 50 ms of pre-impact data and at least 300 ms of post-impact data. Each channel has been adjusted for any direct current offset that may have existed prior to the actual test. Appendix B contains data for the second drop test.

The times of impact were found to be approximately 0.91 seconds after hook release for the first test and 0.99 seconds for the second test. Not all the data from these tests were recovered. Tables 3A and 3B show the status of all the instrumentation used in the first and second tests.

Appendix C is a total time history plot of the first and second tests. These graphs show all significant events during the tests, including initial hook release, impact of the release hook with the aircraft, and impact of the test specimen with the platform.

CONCLUSION

The data collected from these two drop tests serve as a base of comparison with future tests. Drop tests currently being planned are with a Metro III and a number of Beech 1900 aircraft. The data base will eventually be used to establish regulations for improved commuter aircraft seat restraint systems.

TABLE 3A. CHANNEL STATUS - TEST 1

Channel Num	Code	Status	Max Val	Min Val	Units	Filter
1	AA76	GOOD	4.83	-111.43	g	60 Hz
2	DE95	GOOD	3.52	-109.79	g	60 Hz
3	DA74	GOOD	3.50	-101.28	g	60 Hz
4	CX08	GOOD	6.08	-96.33	g	60 Hz
5	DA11	GOOD	11.39	-110.69	g	60 Hz
6	CV29	GOOD	10.72	-114.69	g	60 Hz
7	CY92	GOOD	14.07	-94.09	g	60 Hz
8	AA25	GOOD	10.00	-96.81	g	60 Hz
9	AA87	GOOD	15.45	-76.00	g	60 Hz
10	AA79	GOOD	15.01	-96.50	g	60 Hz
11	AA73	GOOD	5.56	-92.87	g	60 Hz
12	CR31	GOOD	6.66	-109.48	g	60 Hz
13	STR. POT.	NO DATA	NA	NA	NA	NA
14	STR. POT.	NO DATA	NA	NA	NA	NA
15	STR. POT.	NO DATA	NA	NA	NA	NA
16	STR. POT.	NO DATA	NA	NA	NA	NA
17	--	DELETED FROM TEST PLAN				
18	AA49	GOOD	16.81	-58.14	g	60 Hz
19	CA51	GOOD	13.02	-53.73	g	60 Hz
20	DE39	GOOD	11.87	-55.58	g	60 Hz
21	--	DELETED FORM TEST PLAN				
22	AA44	GOOD	65.07	-13.45	g	60 Hz
23	LCELL	GOOD	557.48	-1784.17	Lbs	60 Hz
24	LCELL	GOOD	257.48	-1756.81	Lbs	60 Hz
25	ACCEL	GOOD	2.21	-58.07	g	60 Hz
26	ACCEL	GOOD	8.95	-48.04	g	60 Hz
27	ACCEL	GOOD	3.44	-30.47	g	60 Hz
28	ACCEL	GOOD	2.19	-48.93	g	60 Hz
29	ACCEL	GOOD	5.53	-57.89	g	60 Hz
30	STR. POT.	NO DATA	NA	NA	NA	NA
31	STR. POT.	NO DATA	NA	NA	NA	NA

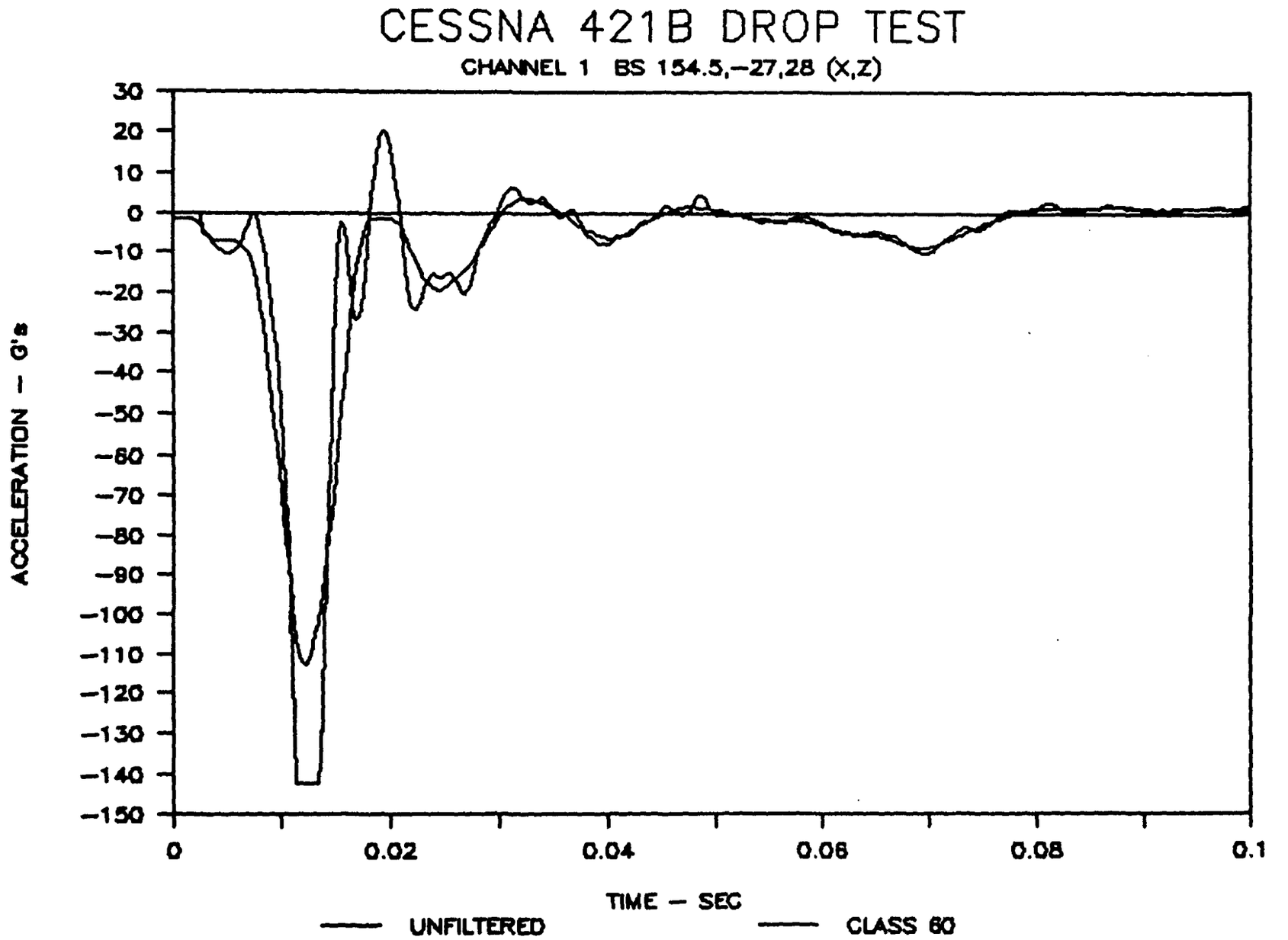
TABLE 3B. CHANNEL STATUS - TEST 2

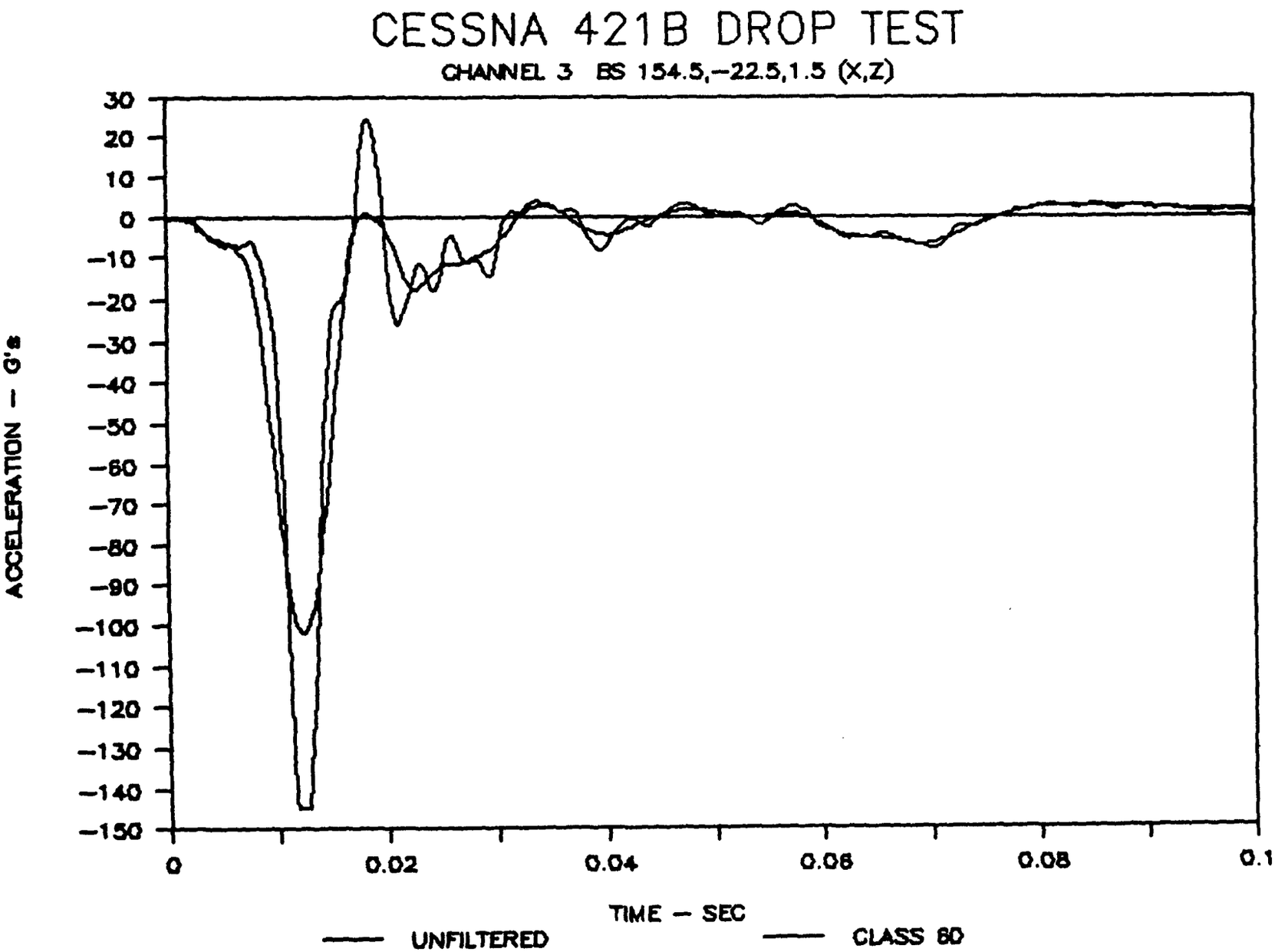
Channel Num	Code	Status	Max Val	Min Val	Units	Filter
1	AA76	NO DATA	NA	NA	NA	NA
2	DE95	#GOOD	33.66	-113.93	g	60 Hz
3	DA74	NO DATA	NA	NA	NA	NA
4	CX08	NO DATA	NA	NA	NA	NA
5	DA11	#GOOD	8.88	-139.56	g	60 Hz
6	CV29	#GOOD	13.62	-124.60	g	60 Hz
7	CY92	GOOD	15.77	-112.66	g	60 Hz
8	AA25	NO DATA	NA	NA	NA	NA
9	AA87	GOOD	16.77	-65.69	g	60 Hz
10	AA79	GOOD	23.10	-47.92	g	60 Hz
11	AA73	GOOD	16.50	-127.35	g	60 Hz
12	CR31	GOOD	10.01	-89.30	g	60 Hz
13	STR. POT.	GOOD	0.33	-0.49	Inches	60 Hz
14	STR. POT.	NO DATA	NA	NA	NA	NA
15	STR. POT.	GOOD	0.36	-1.07	Inches	60 Hz
16	STR. POT.	GOOD	0.30	-0.77	Inches	60 Hz
17	--	DELETED FROM TEST PLAN				
18	AA49	GOOD	37.73	-85.02	g	60 Hz
19	CA51	GOOD	30.54	-93.18	g	60 Hz
20	DE39	GOOD	29.25	-81.00	g	60 Hz
21	--	DELETED FORM TEST PLAN				
22	AA44	#GOOD	25.62	-26.31	g	60 Hz
23	--	DELETED FROM TEST PLAN				
24	ACCEL	NO DATA	NA	NA	NA	NA
25	LCell	GOOD	104.76	-1310.75	Lbs	600 Hz
26	ACCEL	GOOD	6.68	-55.11	g	60 Hz
27	LCell	GOOD	852.76	-1579.19	Lbs	600 Hz
28	ACCEL	GOOD	4.18	-74.51	g	60 Hz
29	ACCEL	GOOD	14.63	-54.75	g	60 Hz
30	STR. POT.	NO DATA	NA	NA	NA	NA
31	STR. POT.	NO DATA	NA	NA	NA	NA

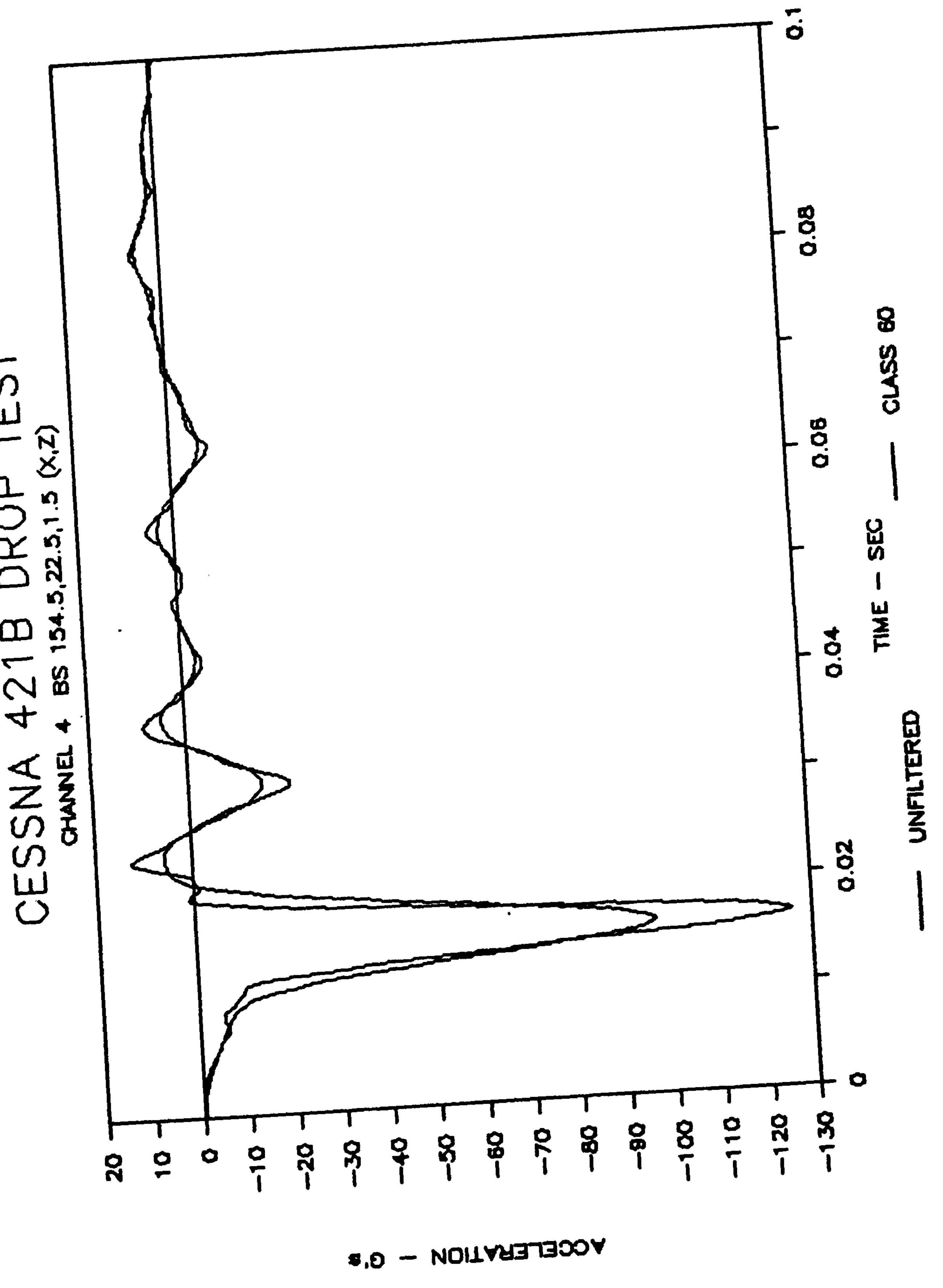
#Channels where instrument broke during test, but only after sufficient data were recorded.

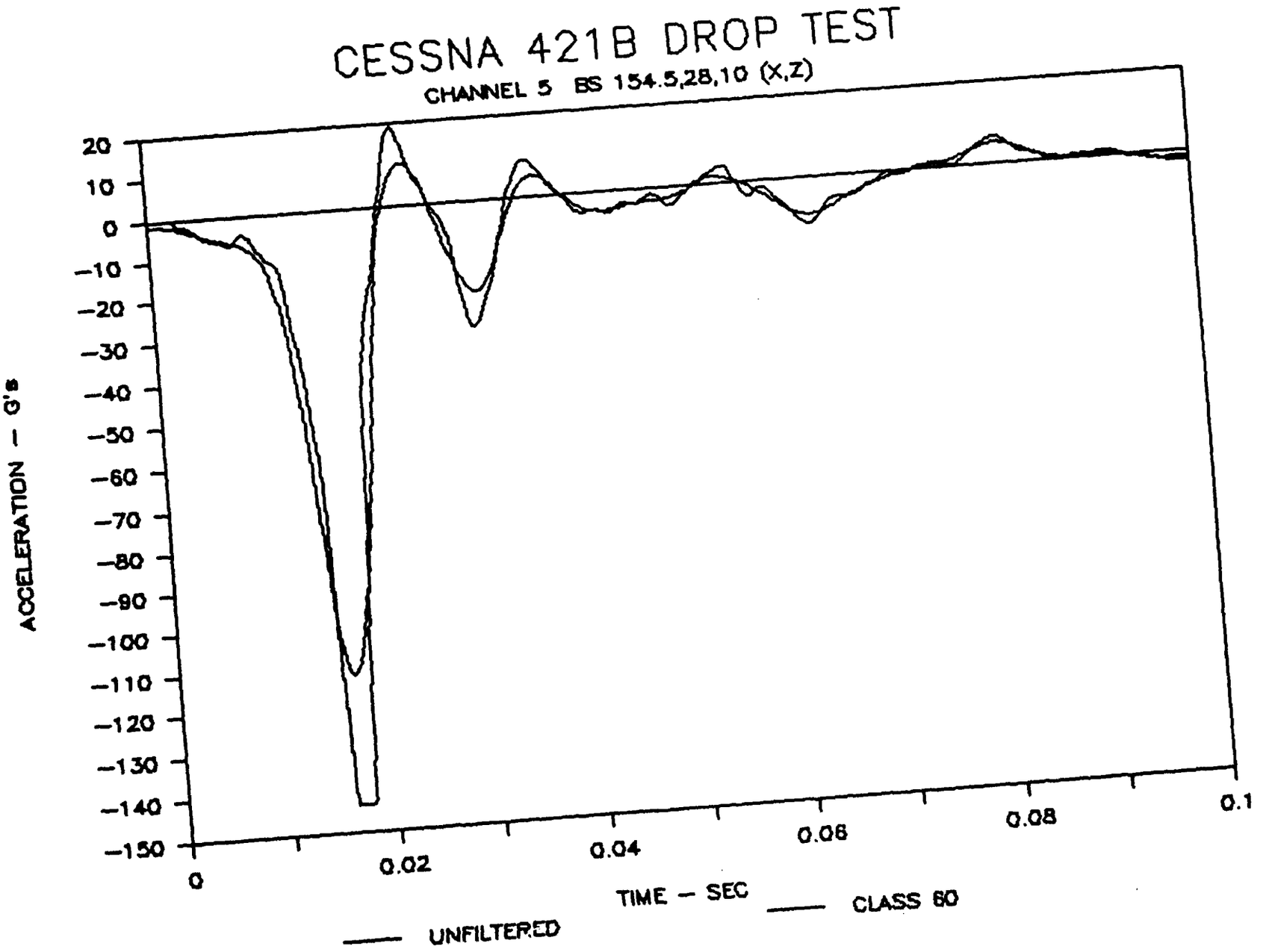
APPENDIX A

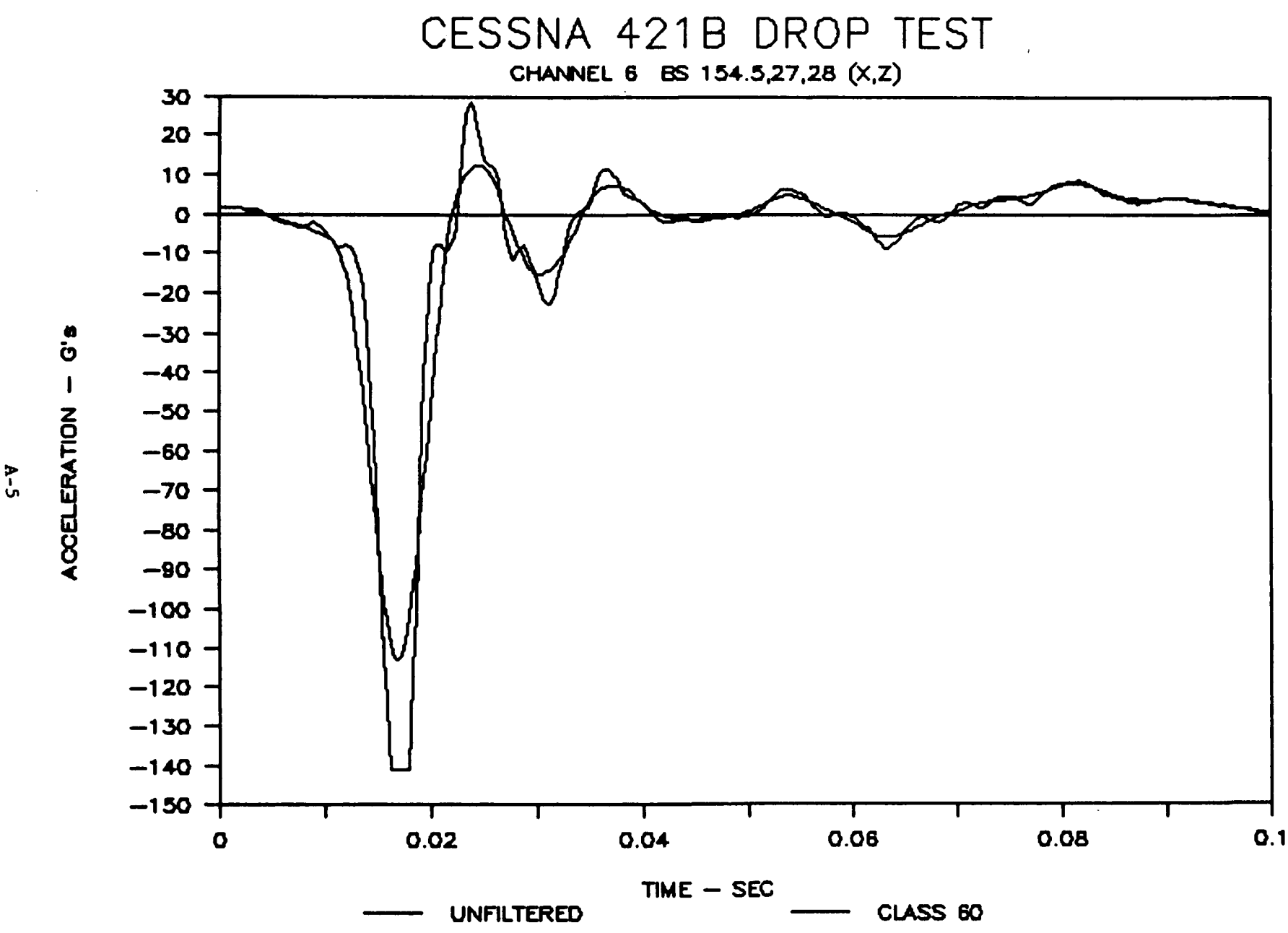
DATA PLOTS - TEST ONE

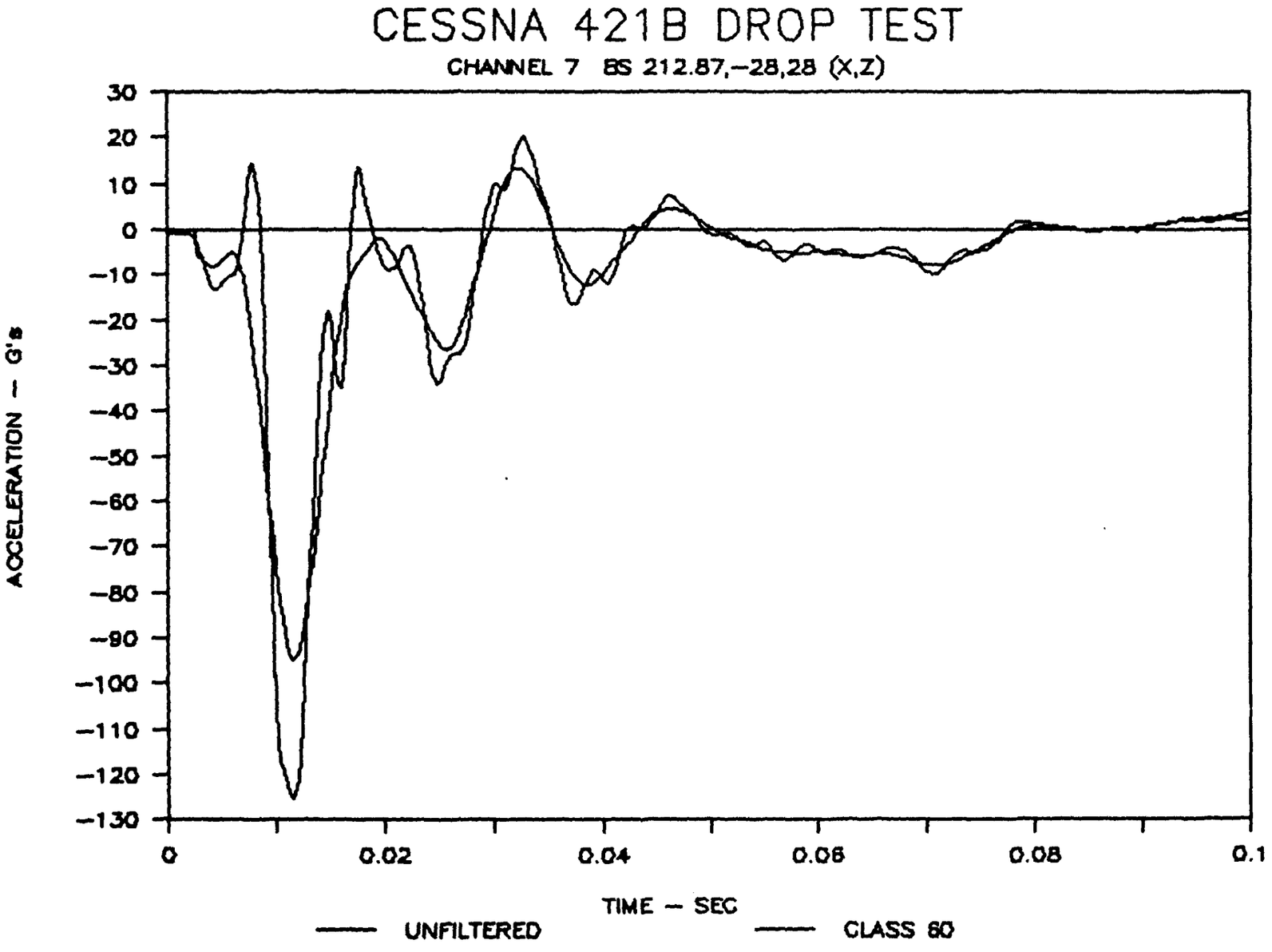

CESSNA 421B DROP TEST
CHANNEL 1 BS 154.5,-27,28 (X,Z)
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
ACCELERATION - G's
0
0.02
0.04
0.06
0.08
0.1
TIME - SEC
UNFILTERED
CLASS 60

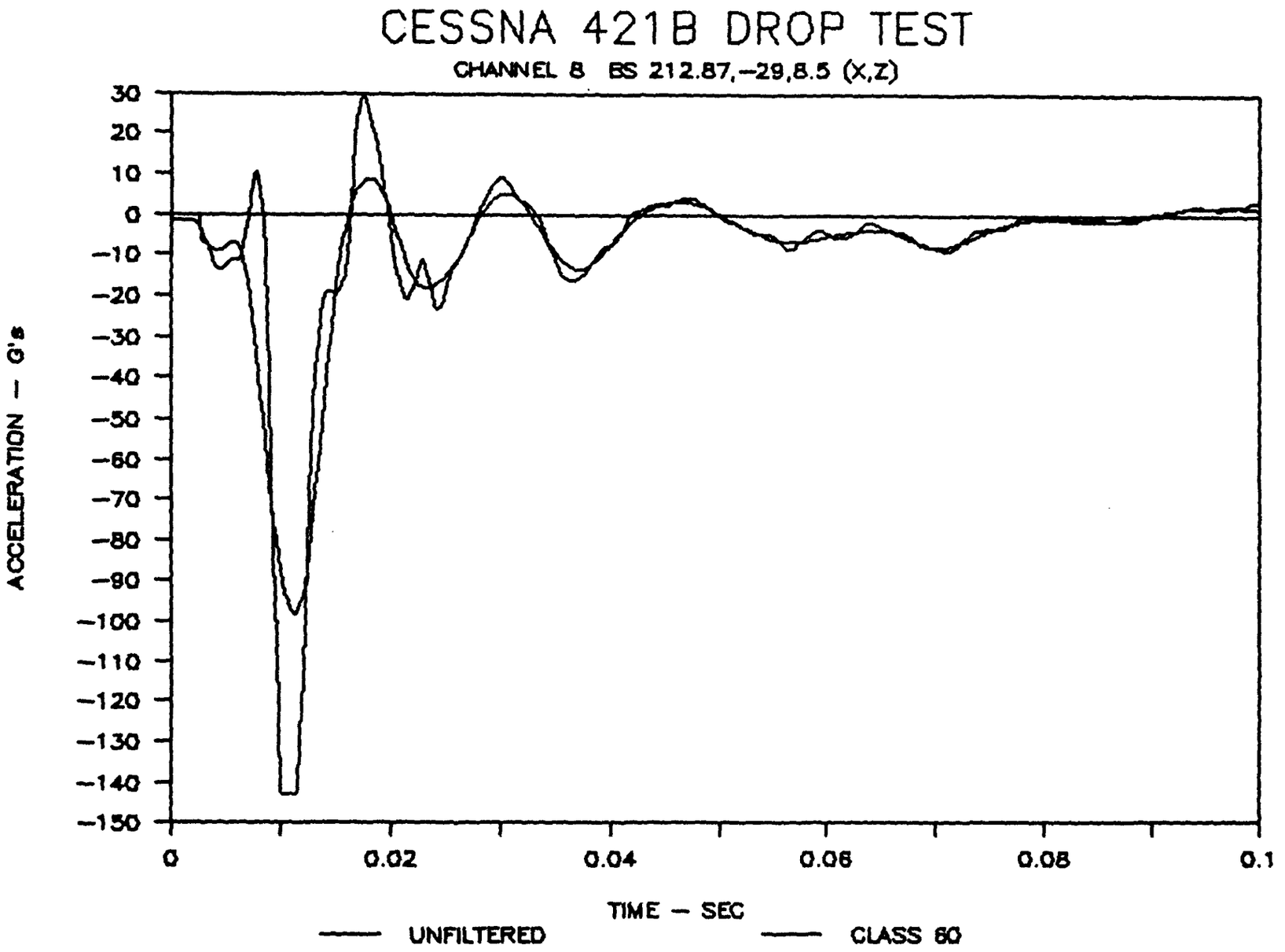

CESSNA 421B DROP TEST
CHANNEL 3 BS 154.5,-22.5,1.5 (X,Z)
ACCELERATION - G's
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
0
0.02
0.04
0.06
0.08
0.1
TIME - SEC
UNFILTERED
CLASS 60

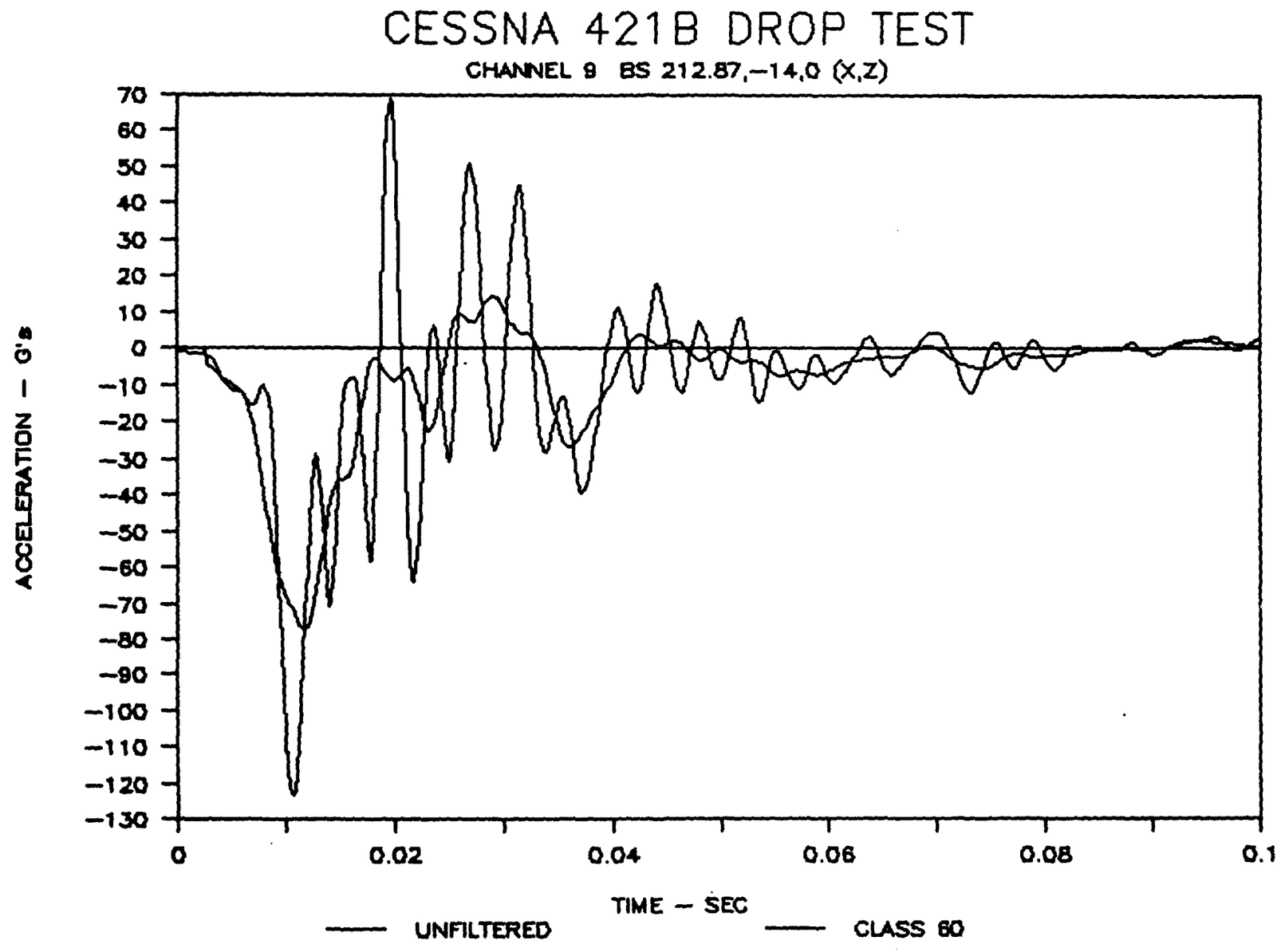

CESSNA 421B DROP TEST
CHANNEL 4 BS 154.5,22.5,1.5 (X,Z)
ACCELERATION — G's
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
0
0.02
0.04
0.06
0.08
0.1
TIME — SEC
UNFILTERED
CLASS 60

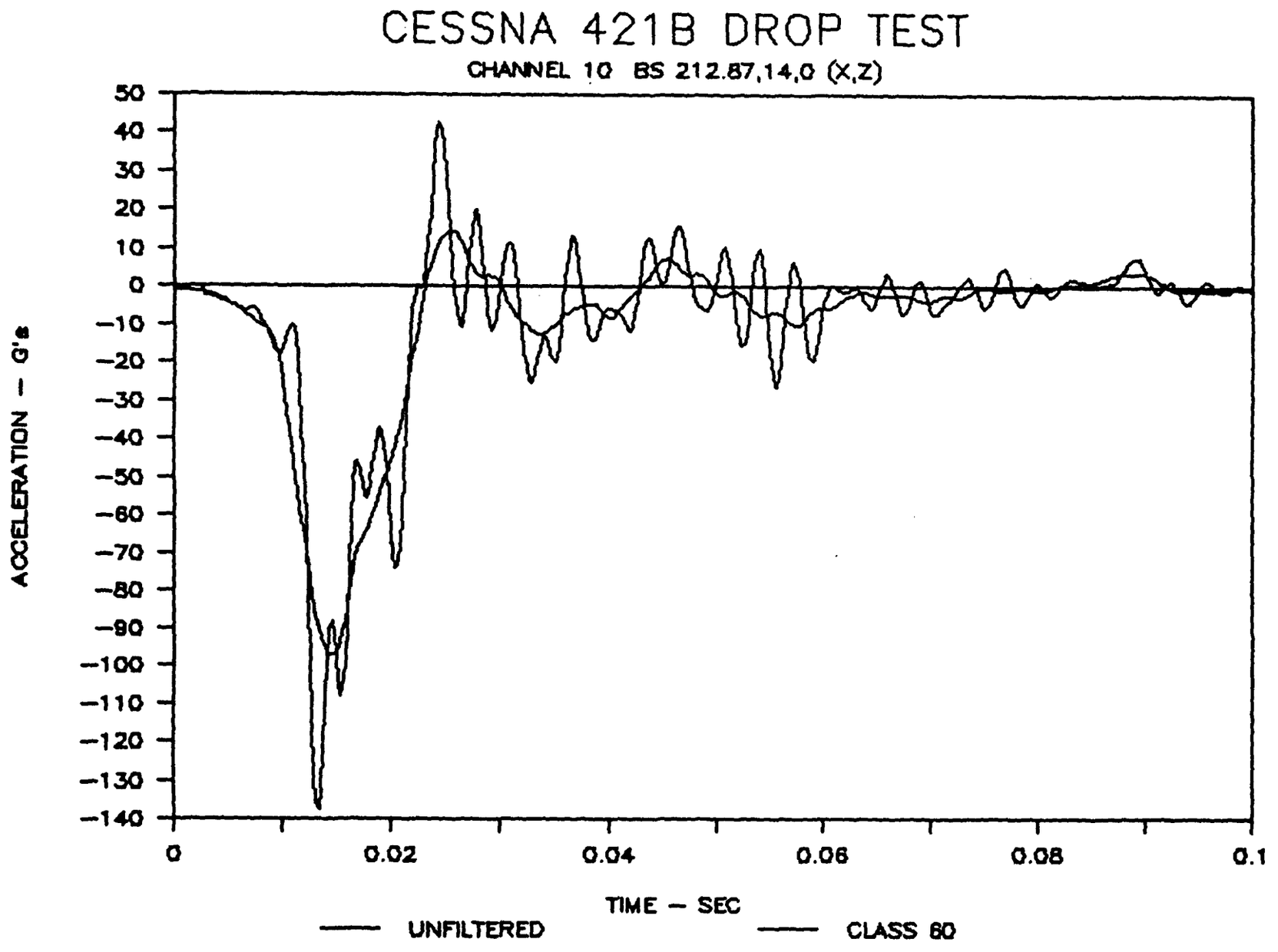

CESSNA 421B DROP TEST
CHANNEL 5 BS 154.5,28,10 (X,Z)
ACCELERATION — G's
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
0
0.02
0.04
0.06
0.08
0.1
TIME — SEC
UNFILTERED
CLASS 60

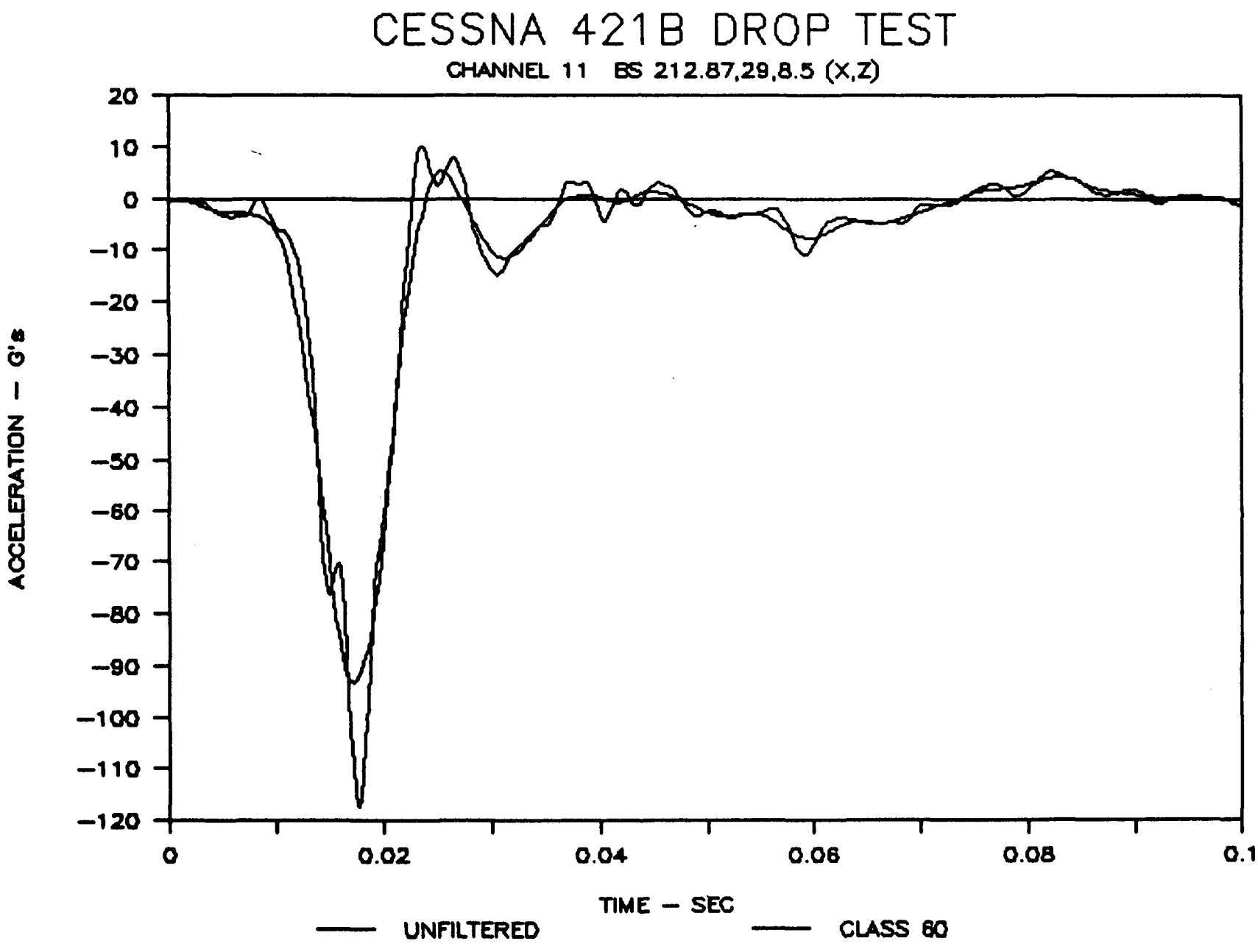

CESSNA 421B DROP TEST
CHANNEL 6 BS 154.5,27,28 (X,Z)
ACCELERATION – G's
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
0
0.02
0.04
0.06
0.08
0.1
TIME – SEC
UNFILTERED
CLASS 60

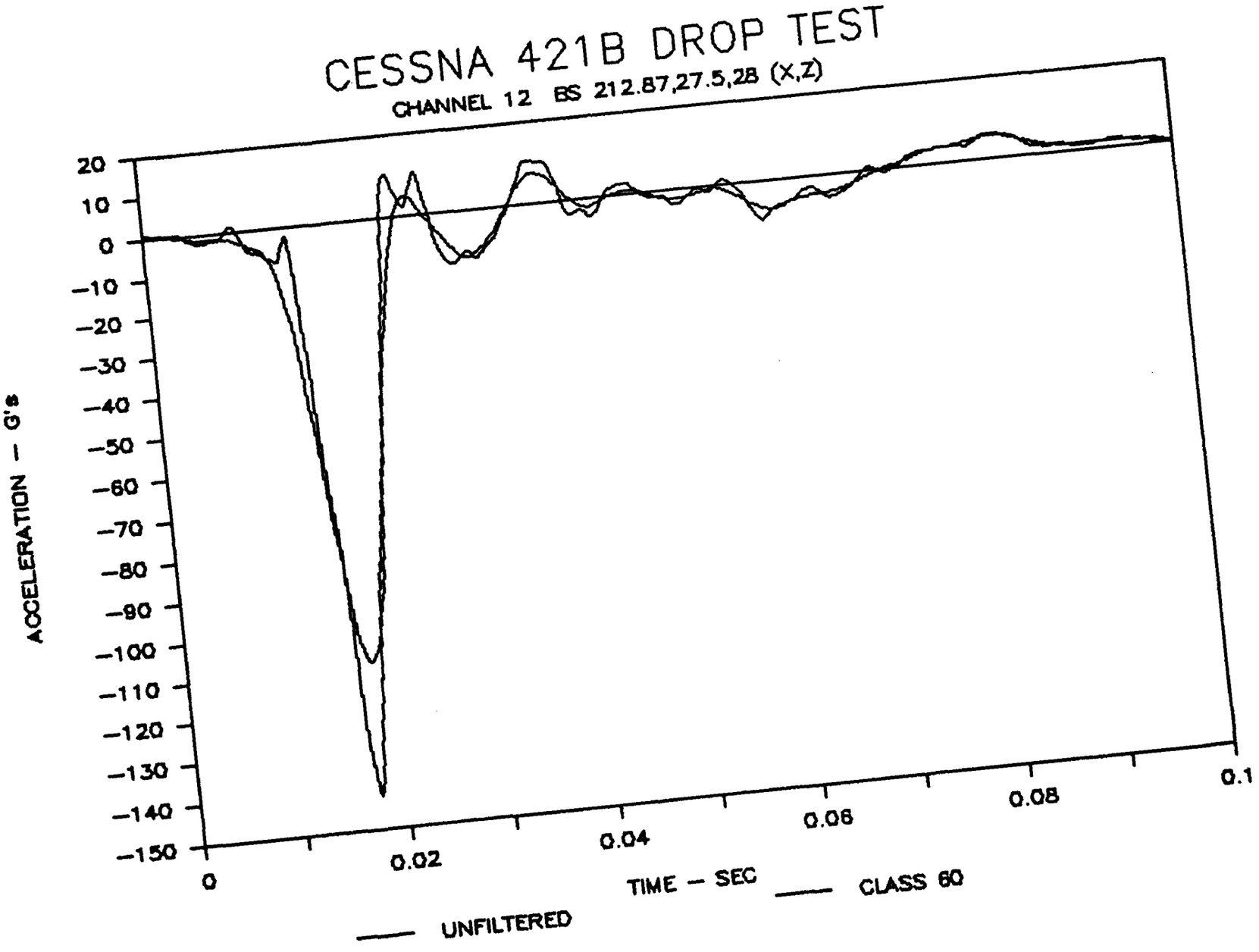

CESSNA 421B DROP TEST
CHANNEL 7 BS 212.87,-28,28 (X,Z)
ACCELERATION — G's
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
0
0.02
0.04
0.06
0.08
0.1
TIME — SEC
UNFILTERED
CLASS 60

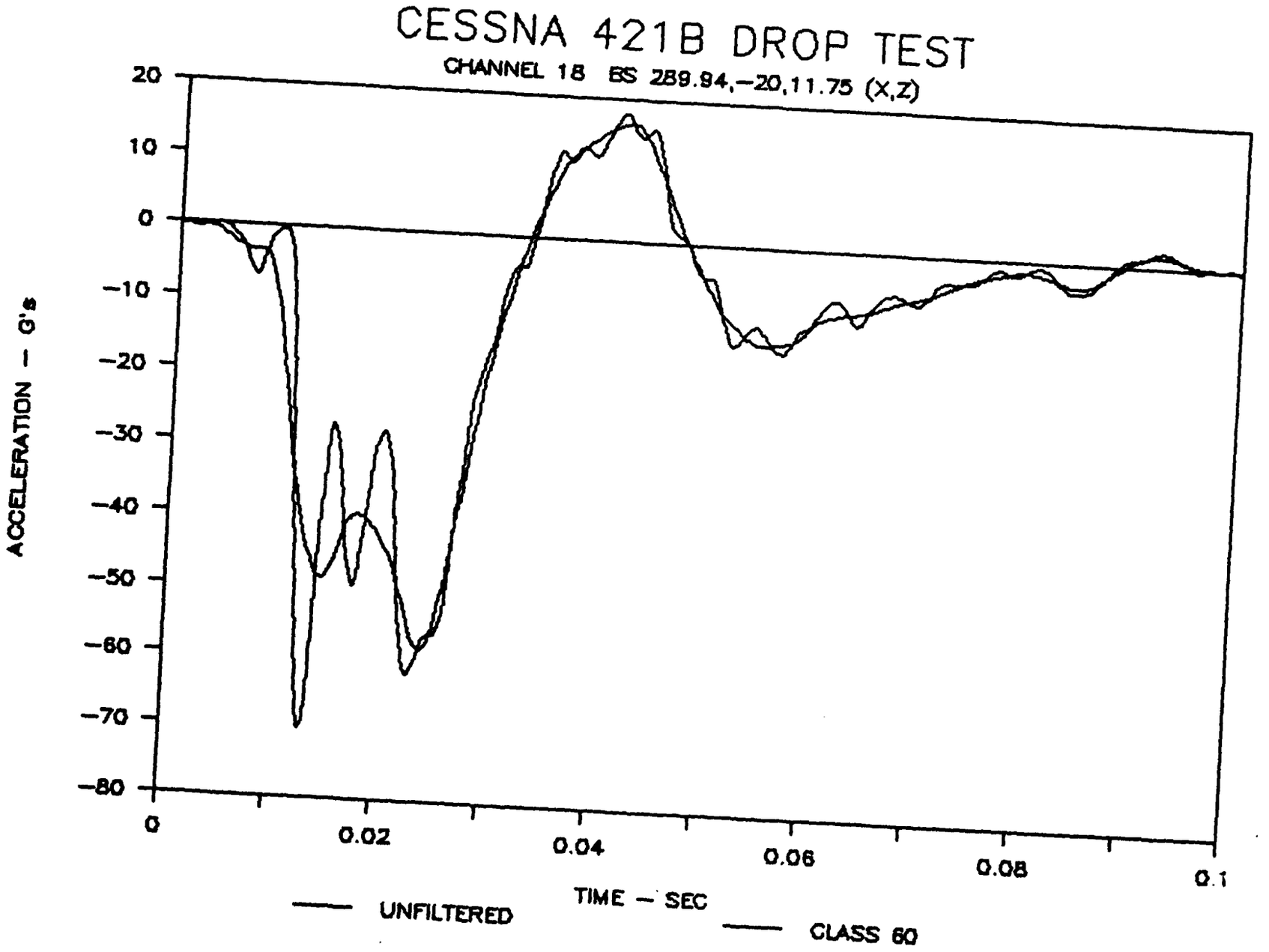

CESSNA 421B DROP TEST
CHANNEL 8 BS 212.87,-29,8.5 (X,Z)
ACCELERATION - G's
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
0
0.02
0.04
0.06
0.08
0.1
TIME - SEC
UNFILTERED
CLASS 60

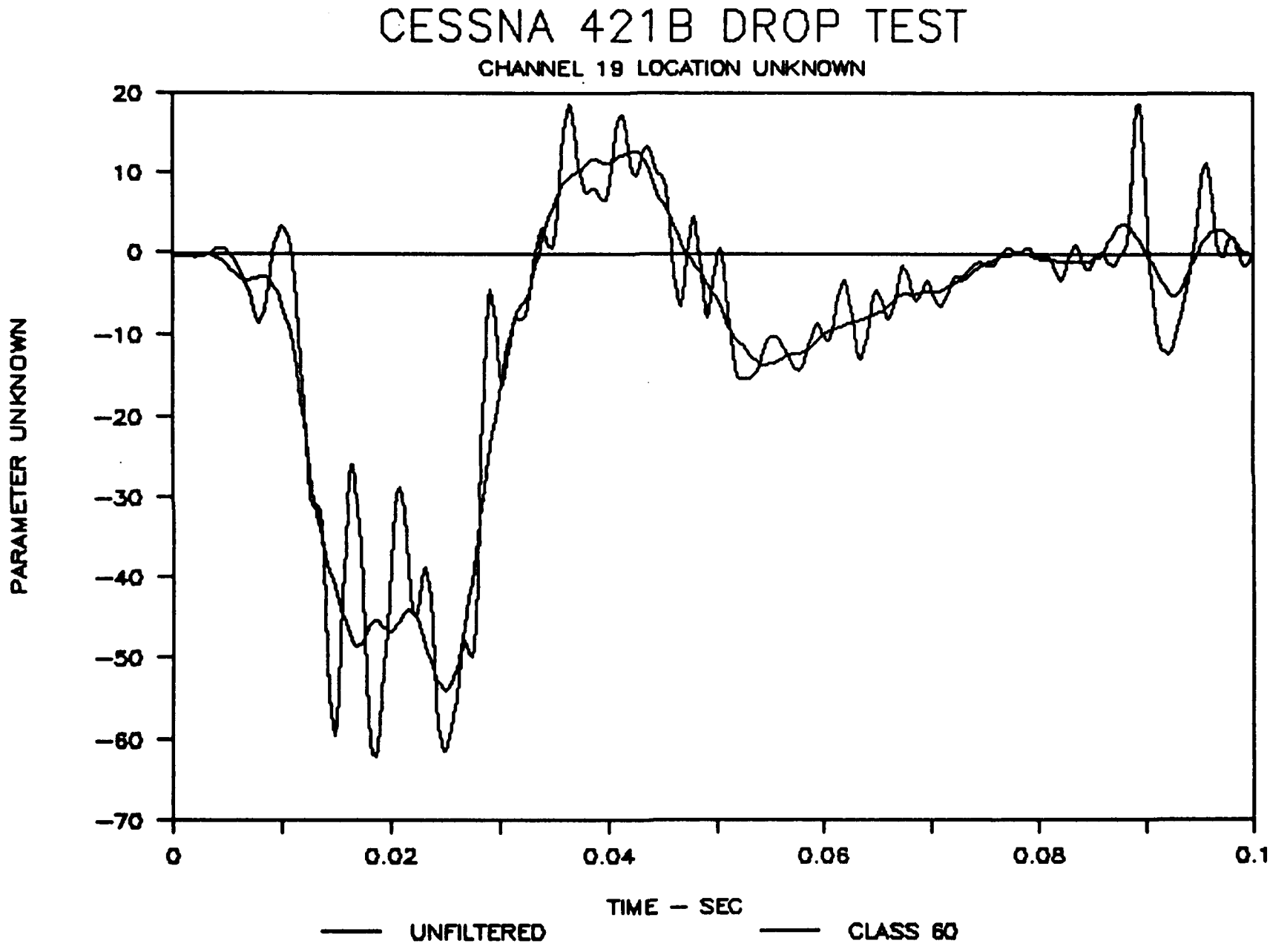

CESSNA 421B DROP TEST
CHANNEL 9 BS 212.87,-14.0 (X,Z)
ACCELERATION — G's
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
0
0.02
0.04
0.06
0.08
0.1
TIME — SEC
UNFILTERED
CLASS 60

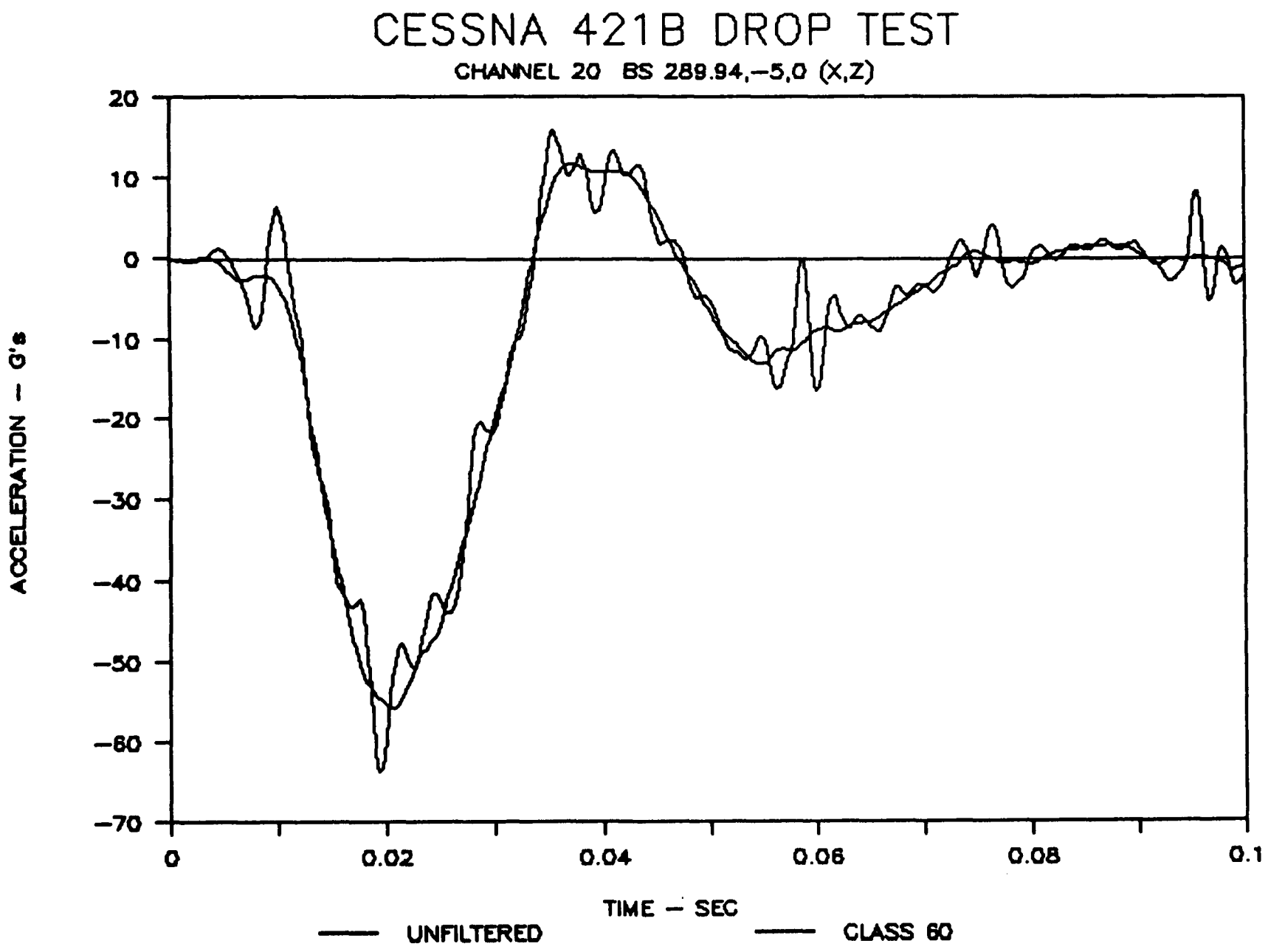

CESSNA 421B DROP TEST
CHANNEL 10 BS 212.87,14,0 (X,Z)
ACCELERATION — G's
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
0
0.02
0.04
0.06
0.08
0.1
TIME — SEC
UNFILTERED
CLASS 60

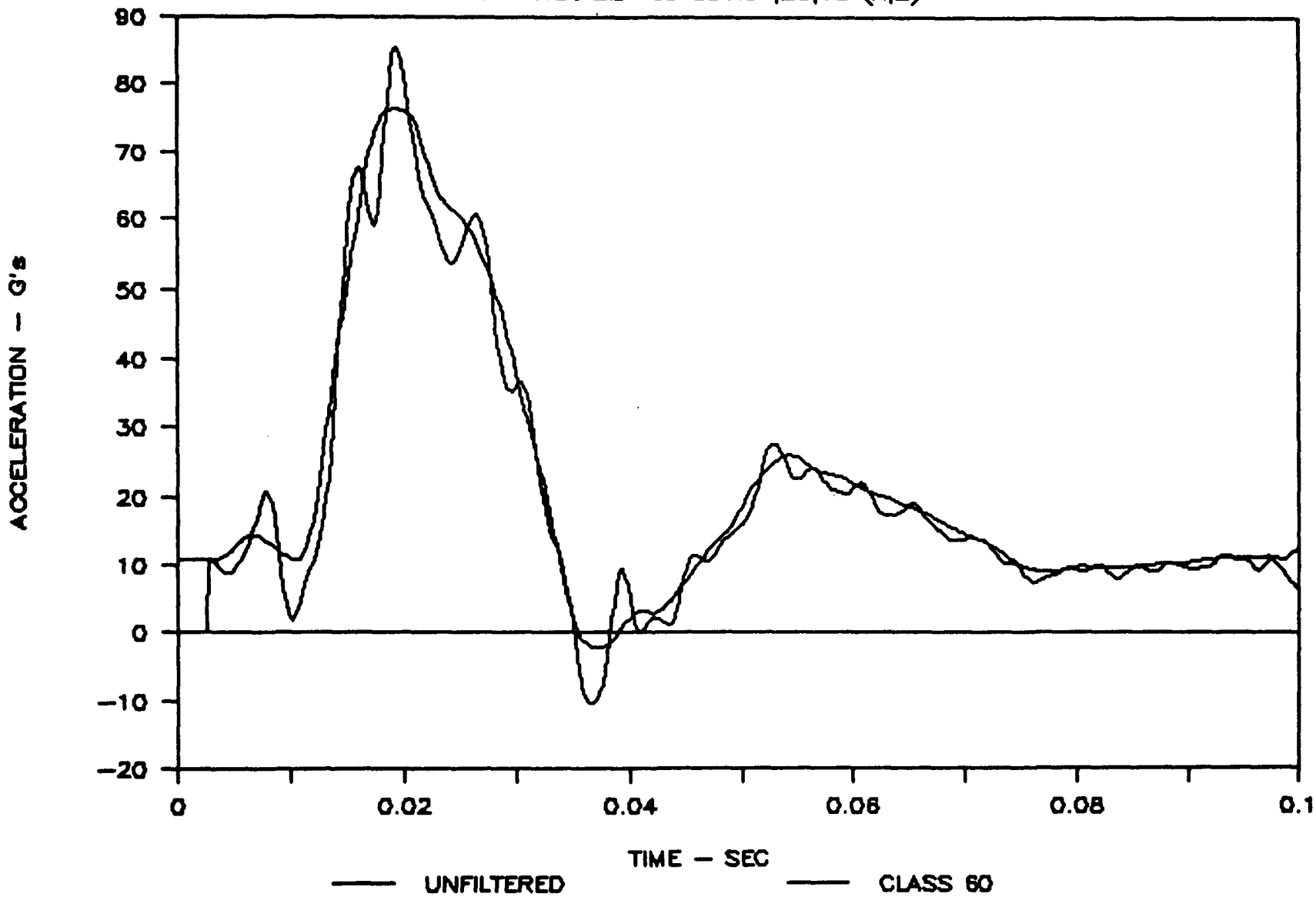

CESSNA 421B DROP TEST
CHANNEL 11 BS 212.87,29,8.5 (X,Z)
ACCELERATION — G's
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
0
0.02
0.04
0.06
0.08
0.1
TIME — SEC
UNFILTERED
CLASS 60

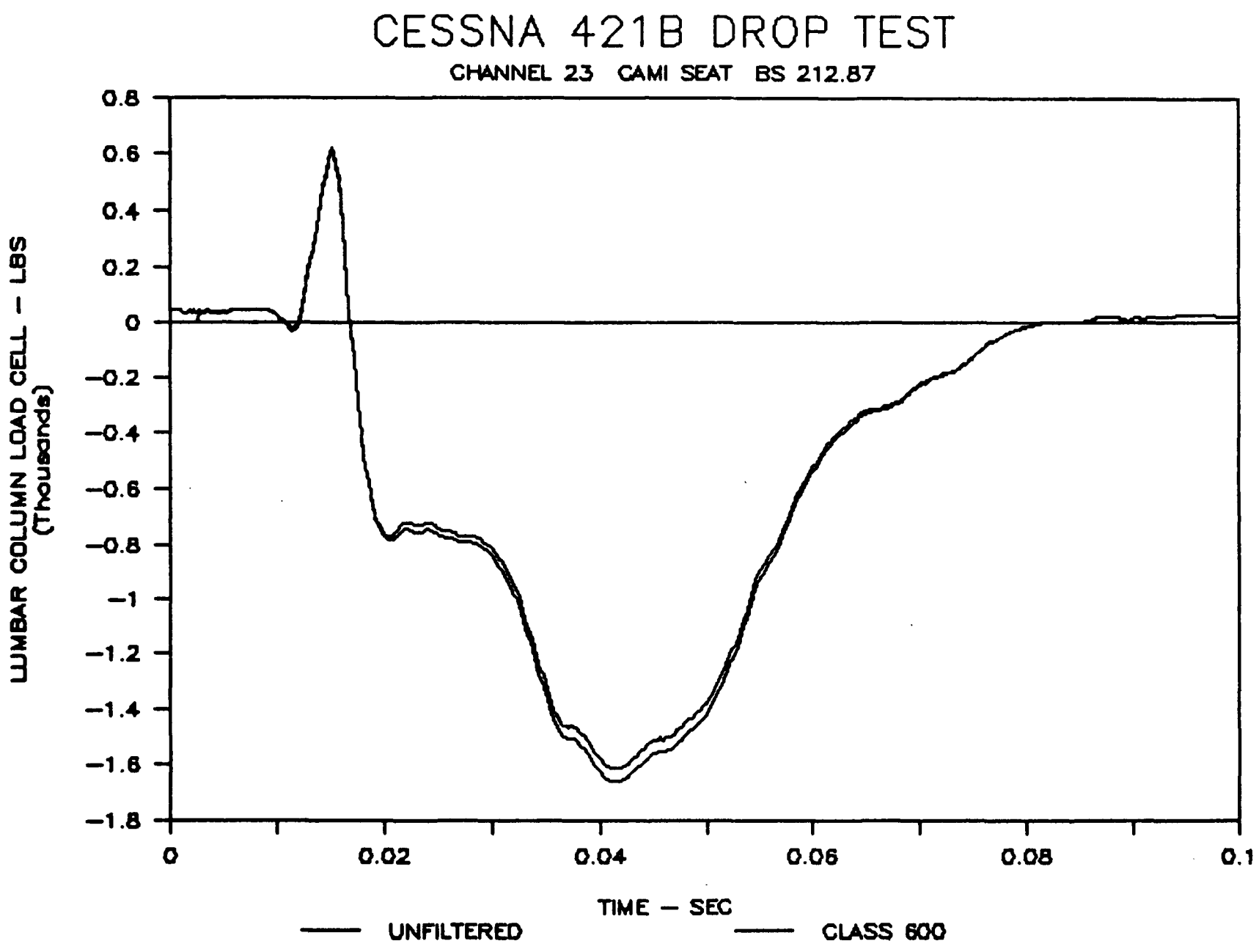

CESSNA 421B DROP TEST
CHANNEL 12 BS 212.87,27.5,28 (X,Z)
ACCELERATION — G's
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
0
0.02
0.04
0.06
0.08
0.1
TIME — SEC
UNFILTERED
CLASS 60

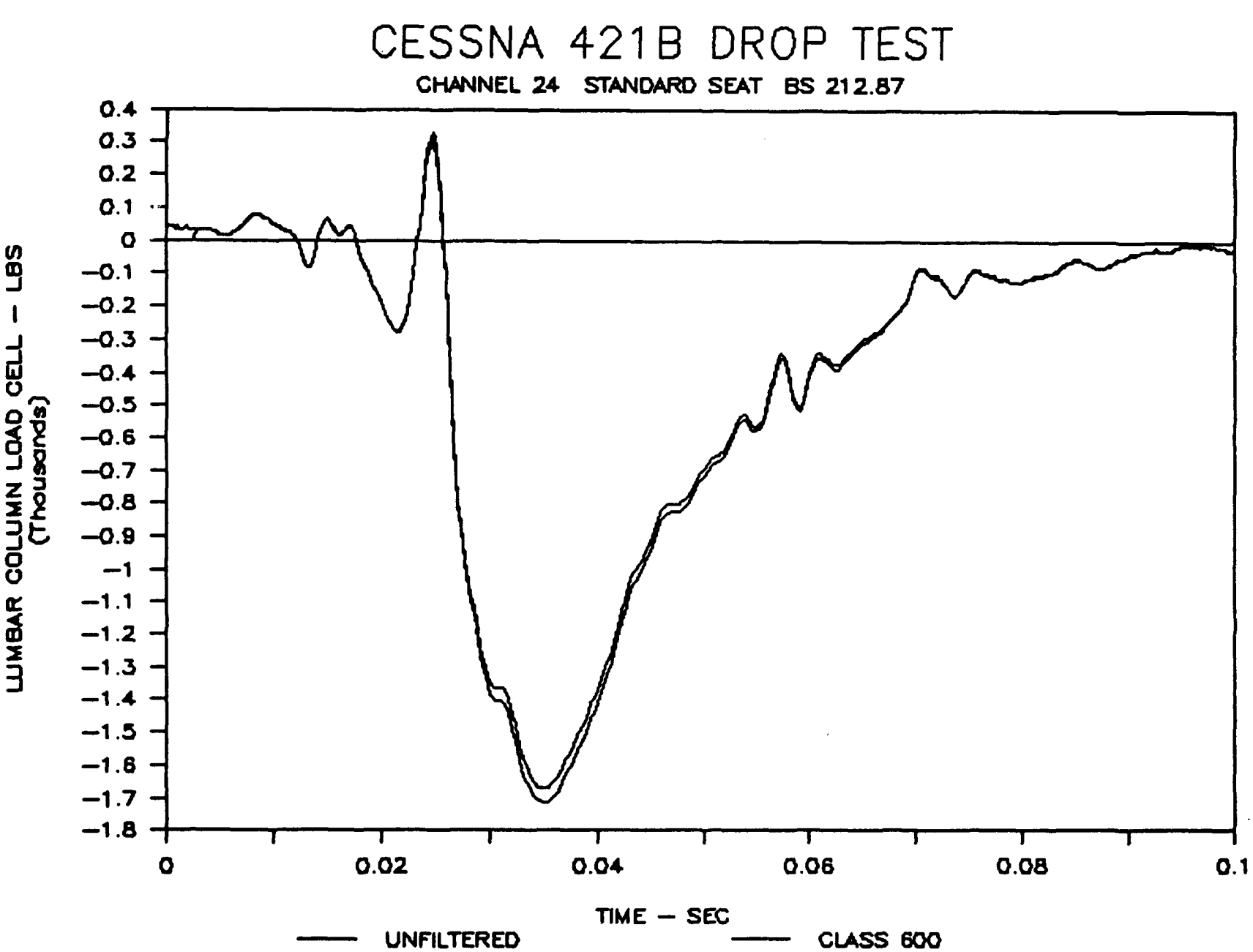

CESSNA 421B DROP TEST
CHANNEL 18 BS 289.94,−20,11.75 (X,Z)
ACCELERATION — G's
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
0
0.02
0.04
0.06
0.08
0.1
TIME — SEC
UNFILTERED
CLASS 60

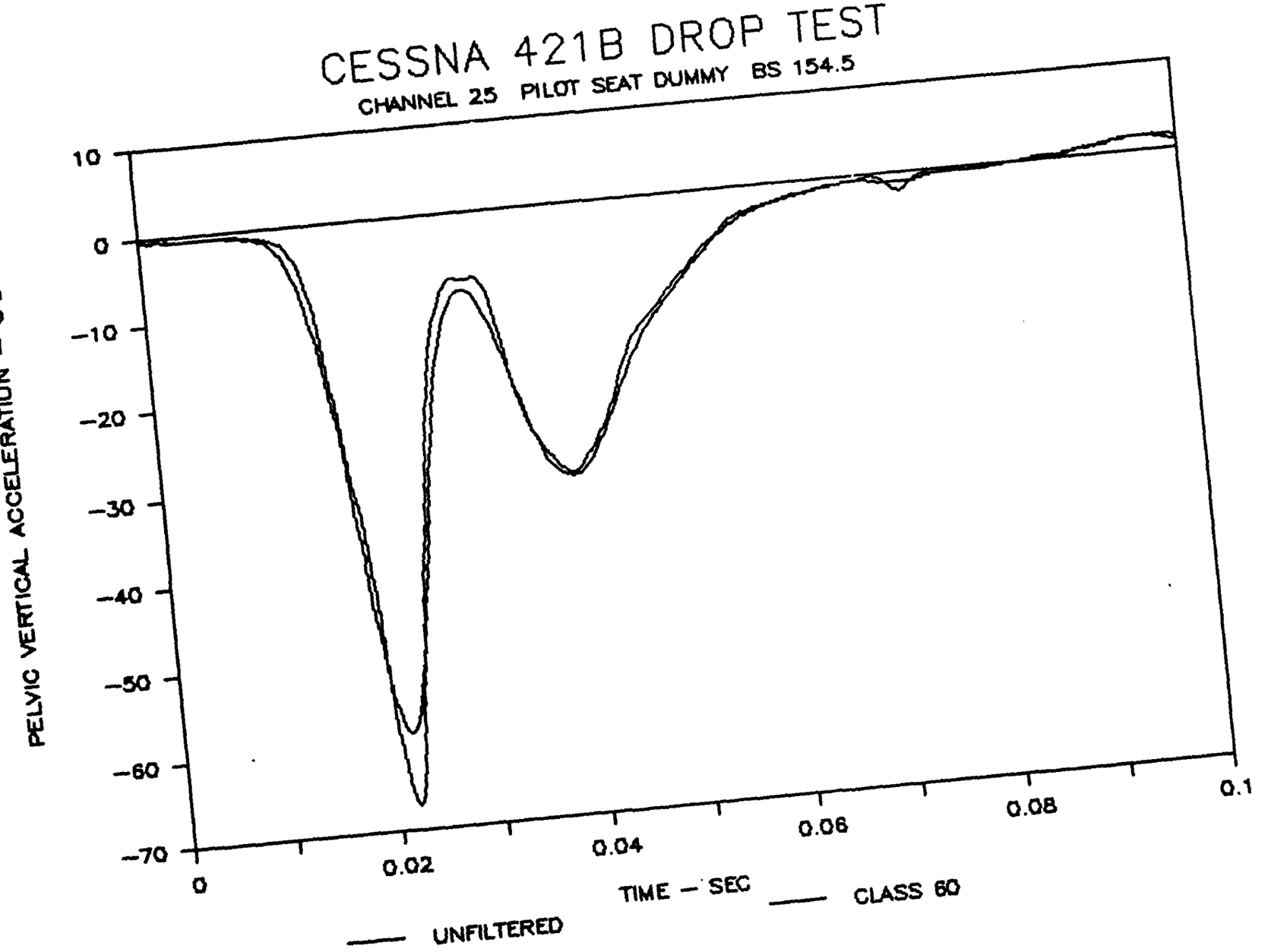

CESSNA 421B DROP TEST
CHANNEL 19 LOCATION UNKNOWN
PARAMETER UNKNOWN
20
10
0
-10
-20
-30
-40
-50
-60
-70
0
0.02
0.04
0.06
0.08
0.1
TIME – SEC
UNFILTERED
CLASS 60

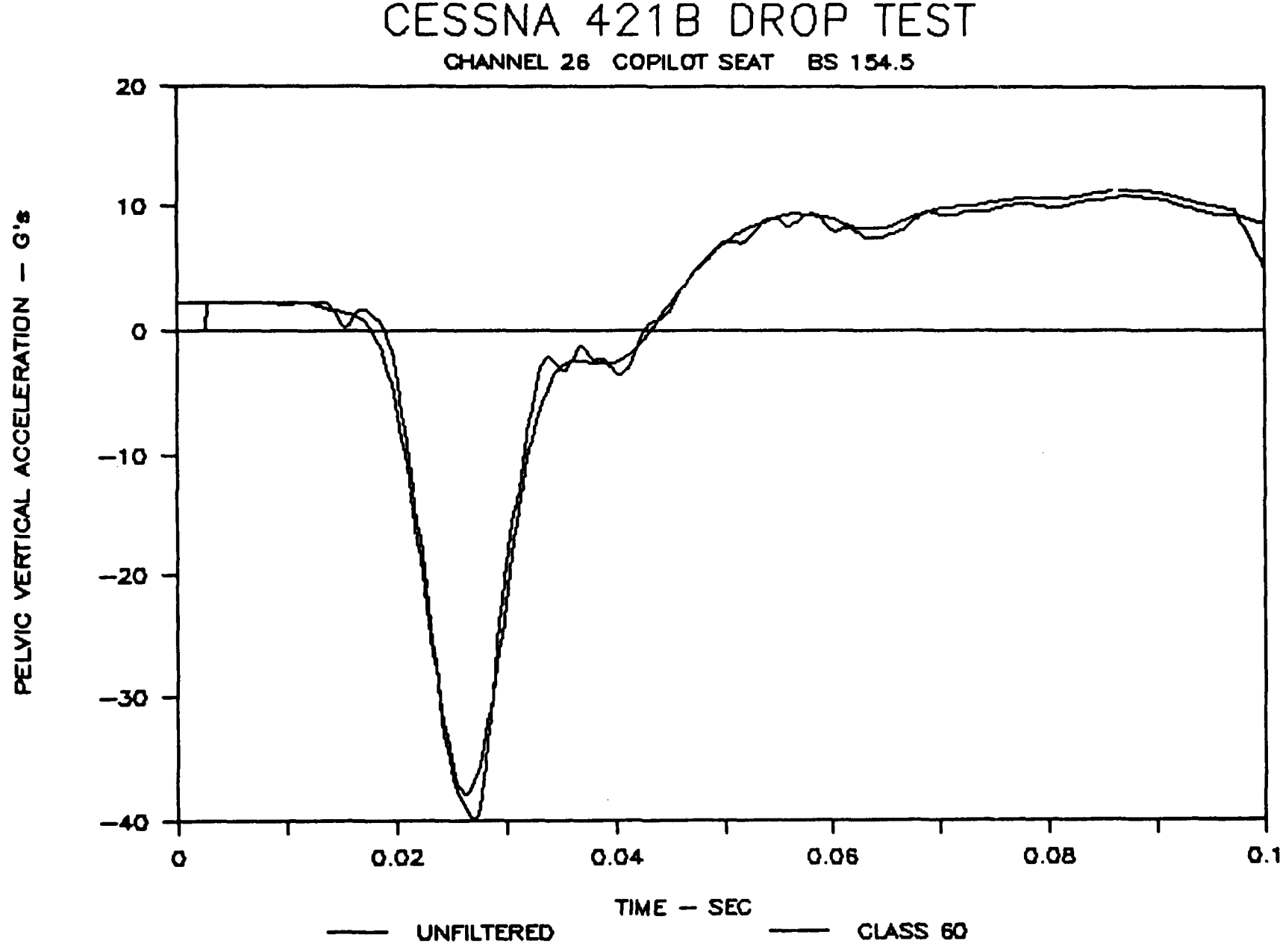

CESSNA 421B DROP TEST
CHANNEL 20 BS 289.94,-5,0 (X,Z)
ACCELERATION - G's
20
10
0
-10
-20
-30
-40
-50
-60
-70
0
0.02
0.04
0.06
0.08
0.1
TIME - SEC
UNFILTERED
CLASS 60

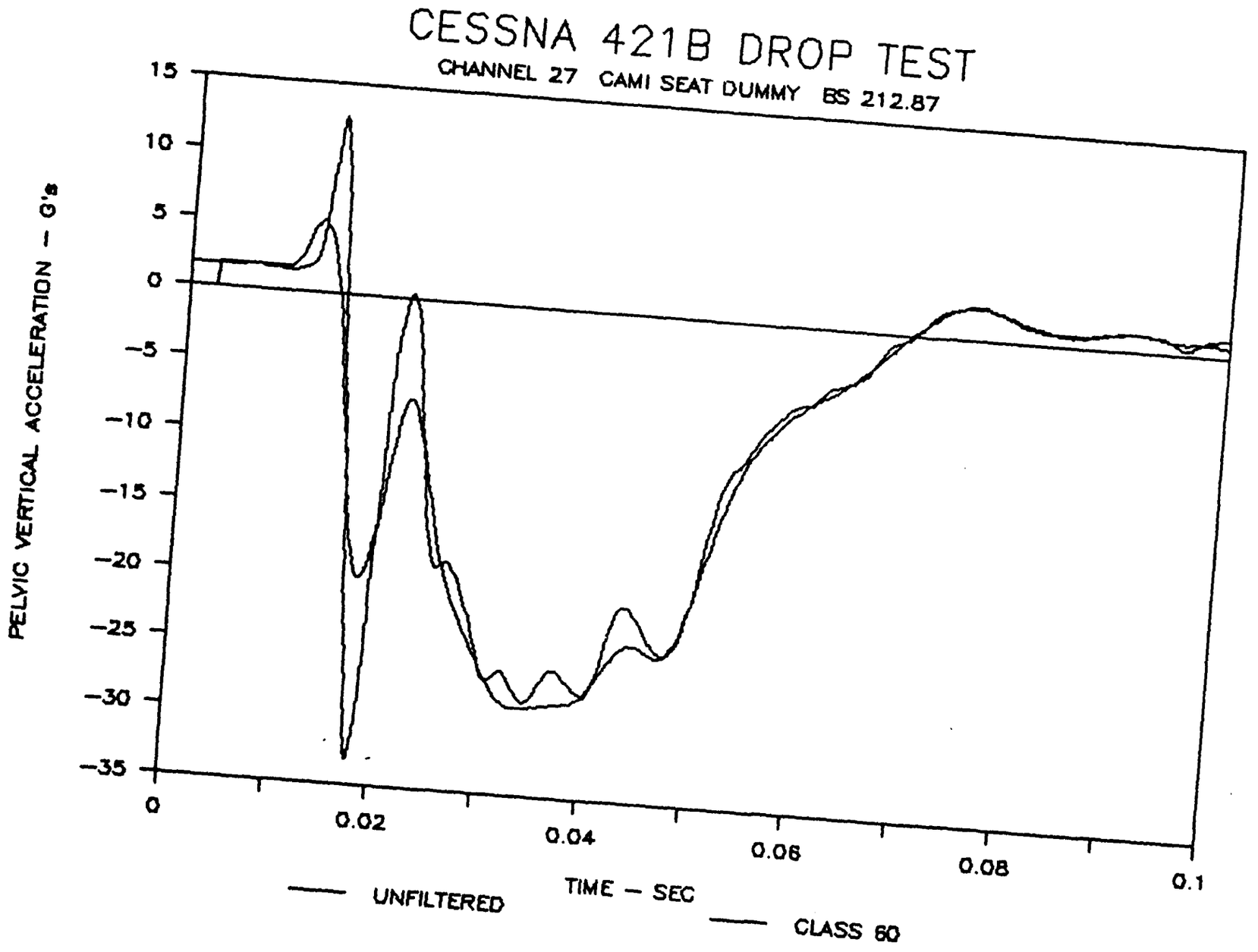

CESSNA 421B DROP TEST
CHANNEL 22 BS 289.94,20,13 (X,Z)
ACCELERATION – G's
90
80
70
60
50
40
30
20
10
0
–10
–20
0
0.02
0.04
0.06
0.08
0.1
TIME – SEC
UNFILTERED
CLASS 60

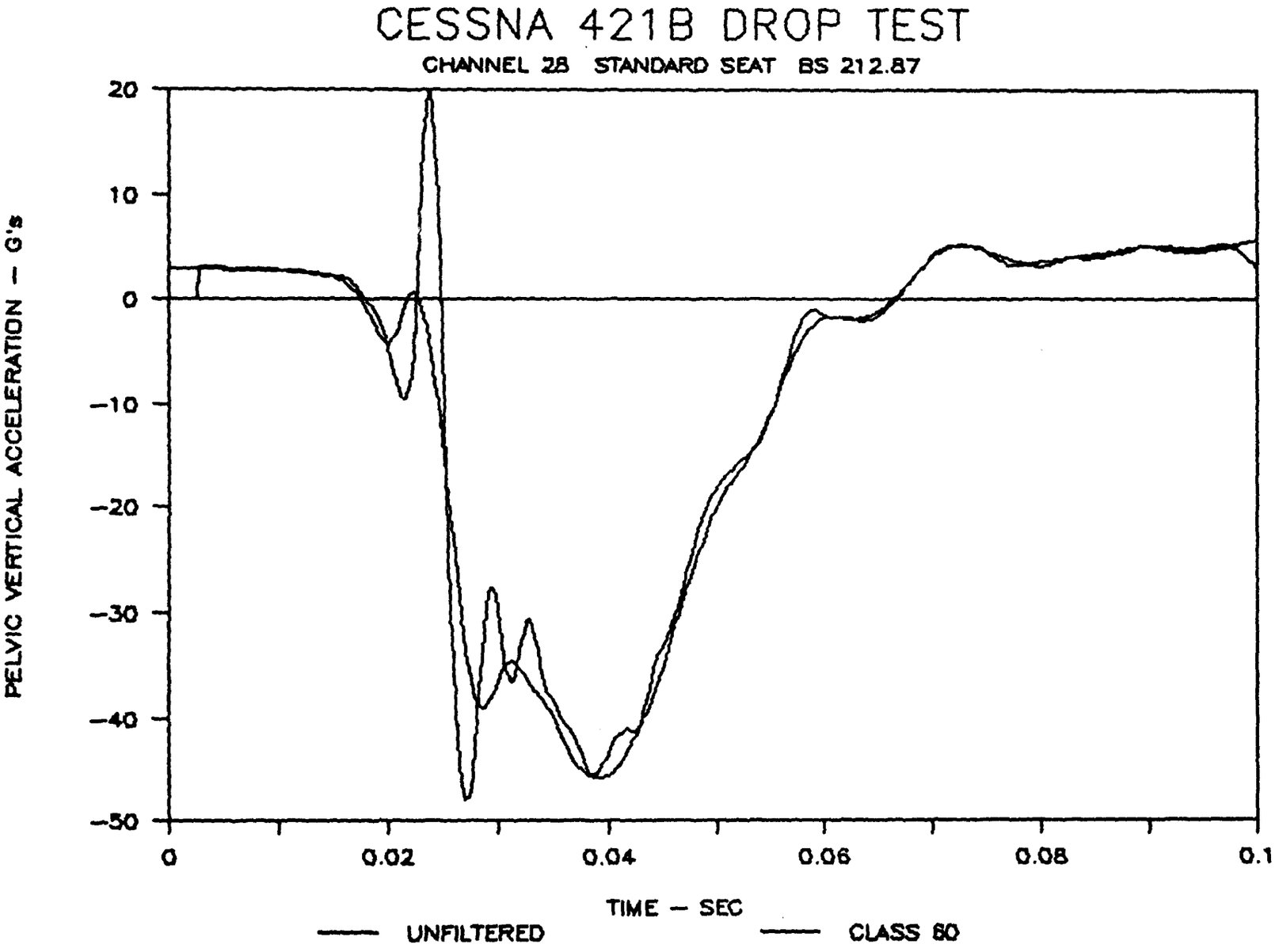

CESSNA 421B DROP TEST
CHANNEL 23 CAMI SEAT BS 212.87
LUMBAR COLUMN LOAD CELL - LBS
(Thousands)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
0
0.02
0.04
0.06
0.08
0.1
TIME - SEC
UNFILTERED
CLASS 600

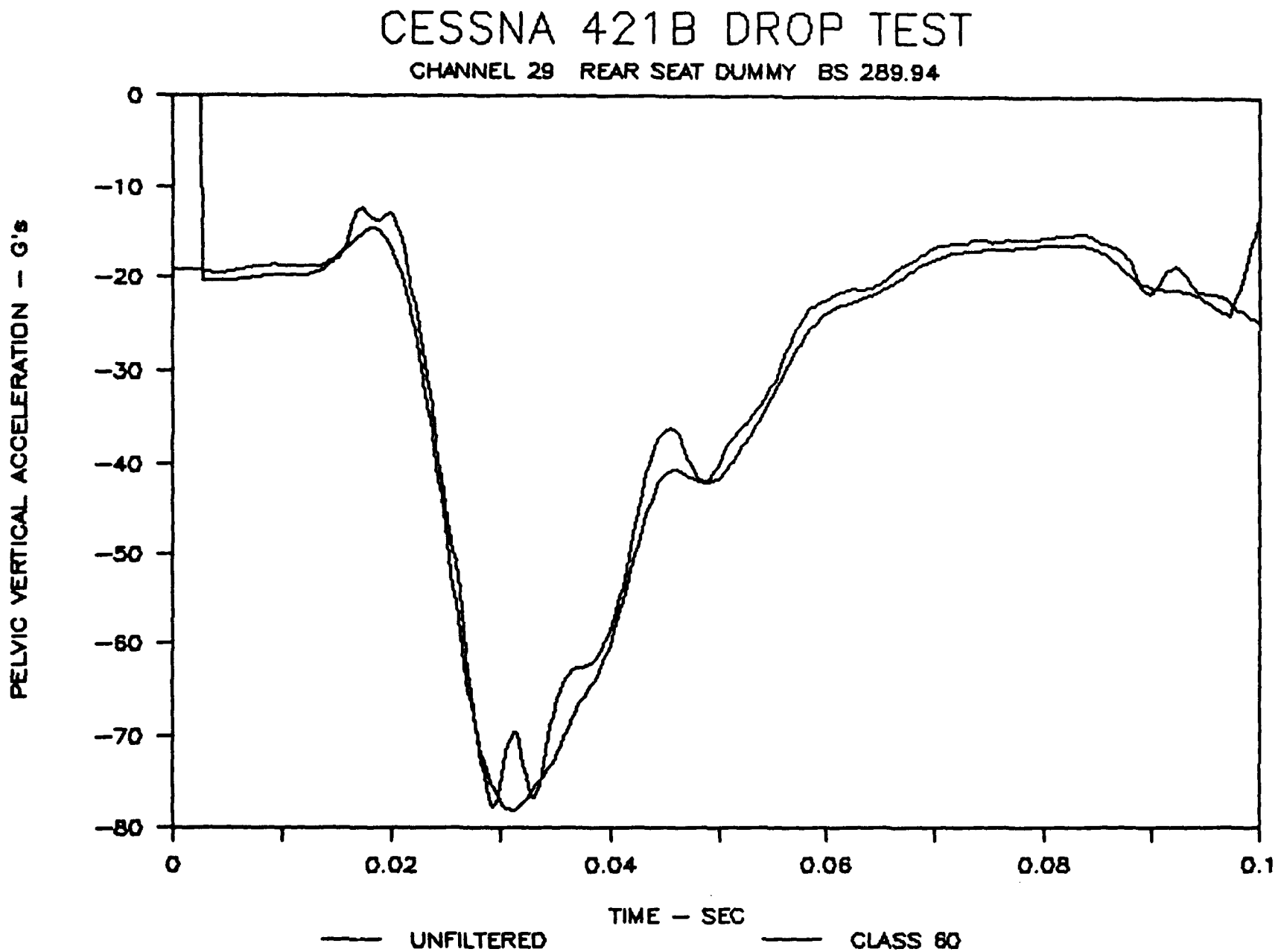

CESSNA 421B DROP TEST
CHANNEL 24 STANDARD SEAT BS 212.87
LUMBAR COLUMN LOAD CELL – LBS
(Thousands)
0.4
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1
−1.1
−1.2
−1.3
−1.4
−1.5
−1.6
−1.7
−1.8
0
0.02
0.04
0.06
0.08
0.1
TIME – SEC
UNFILTERED
CLASS 600

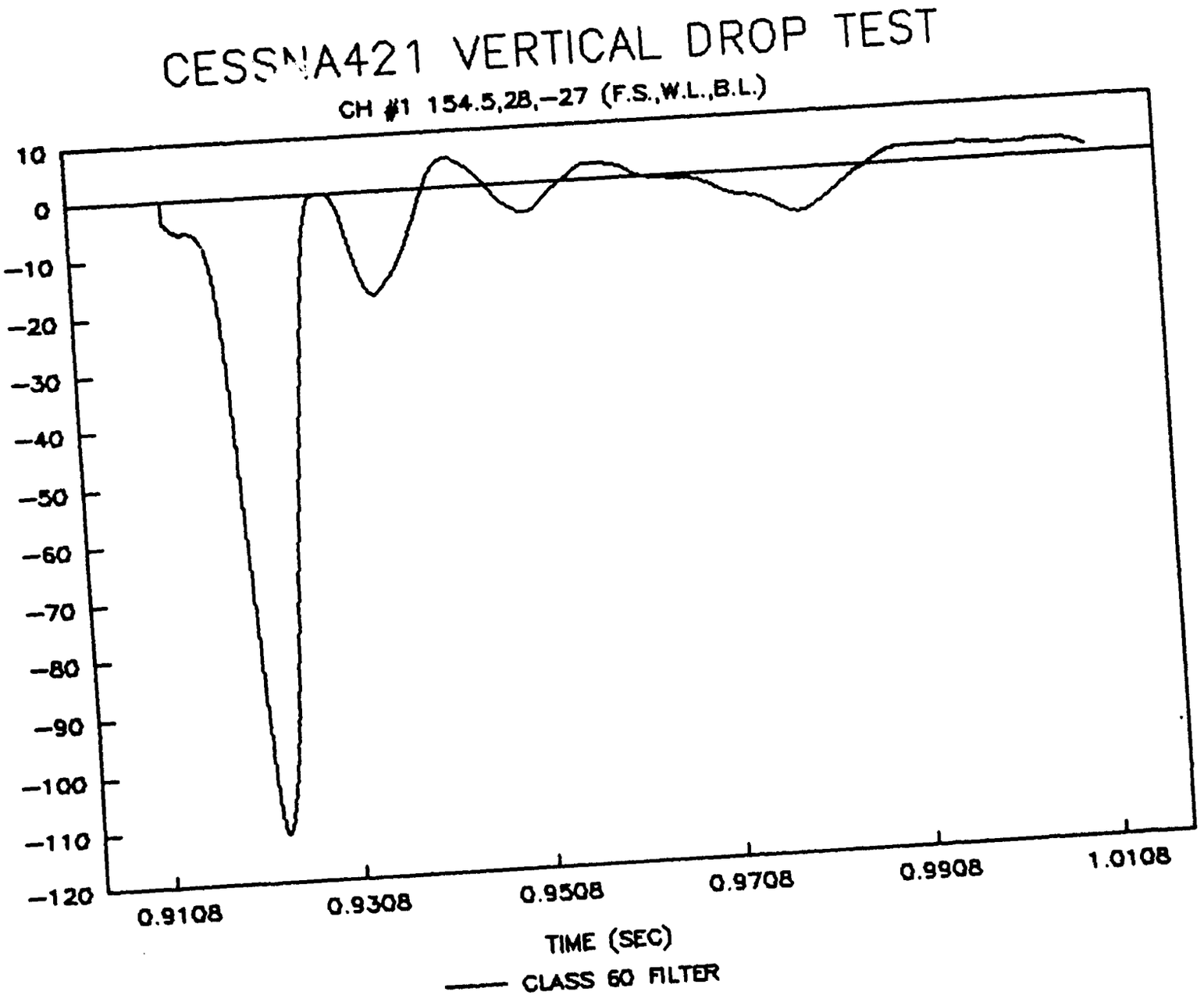

CESSNA 421B DROP TEST
CHANNEL 25 PILOT SEAT DUMMY BS 154.5
PELVIC VERTICAL ACCELERATION — G's
10
0
-10
-20
-30
-40
-50
-60
-70
0
0.02
0.04
0.06
0.08
0.1
TIME — SEC
UNFILTERED
CLASS 60

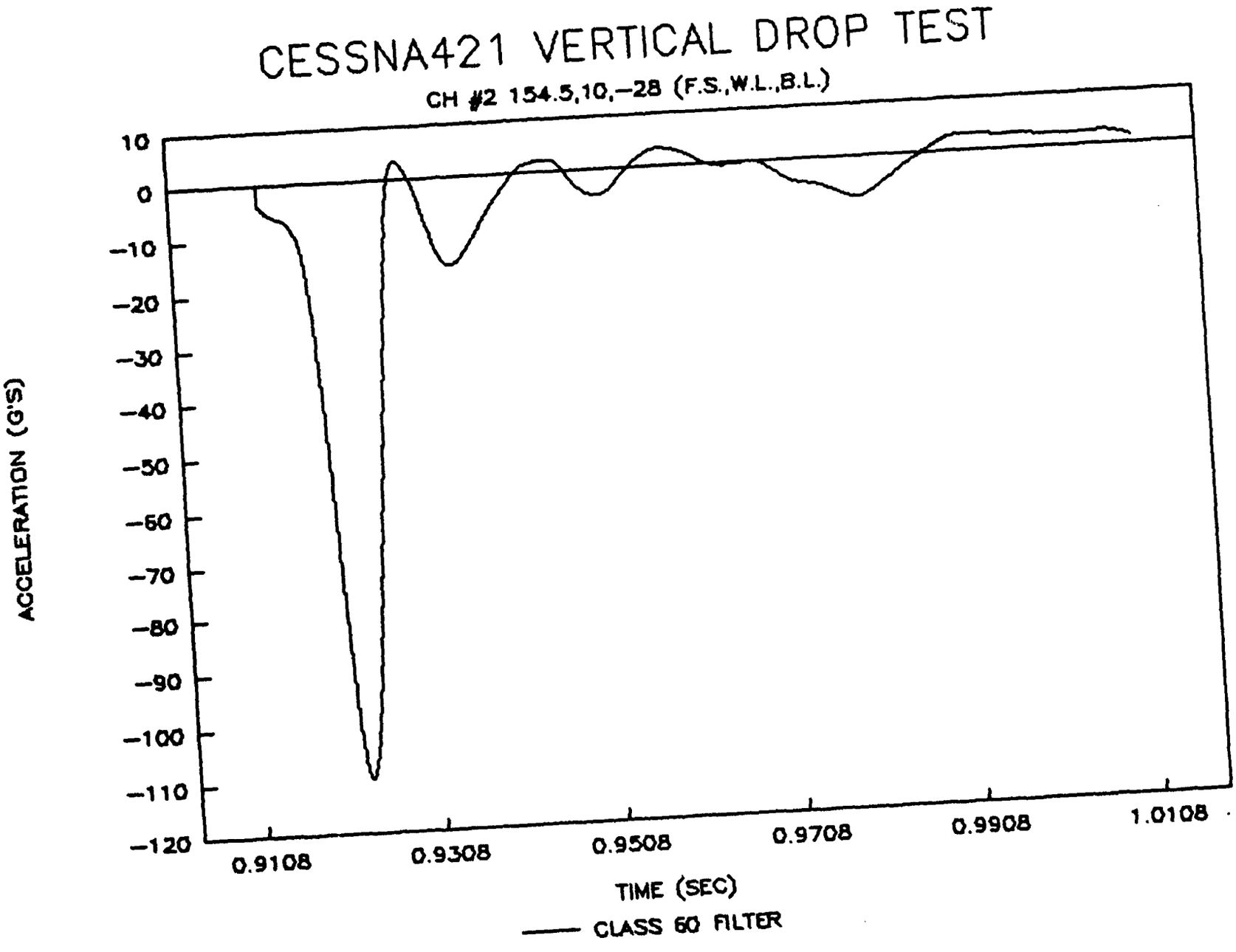

CESSNA 421B DROP TEST
CHANNEL 26 COPILOT SEAT BS 154.5
PELVIC VERTICAL ACCELERATION — G's
20
10
0
-10
-20
-30
-40
0
0.02
0.04
0.06
0.08
0.1
TIME — SEC
UNFILTERED
CLASS 60

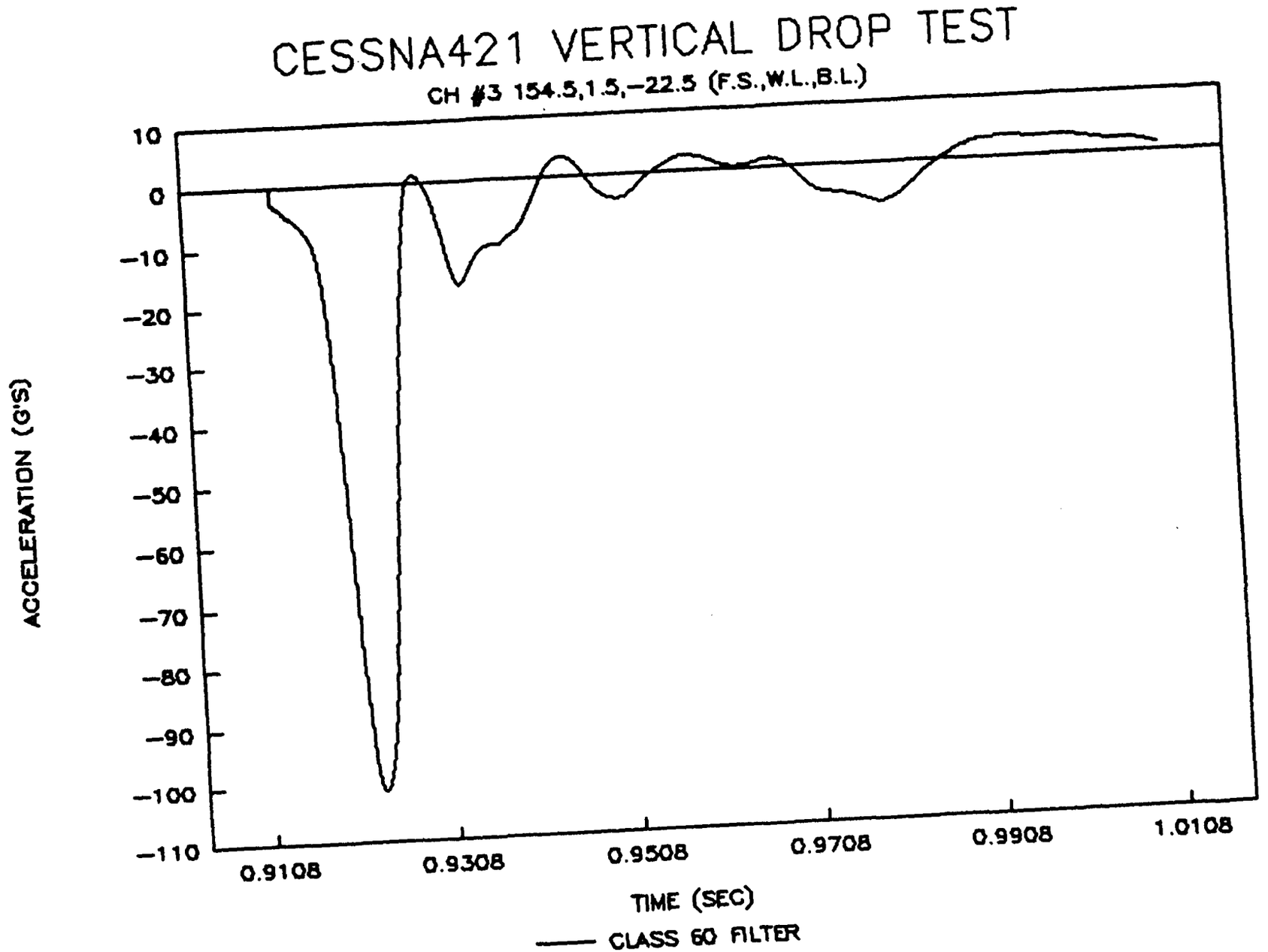

CESSNA 421B DROP TEST
CHANNEL 27 CAMI SEAT DUMMY BS 212.87
PELVIC VERTICAL ACCELERATION – G's
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
0
0.02
0.04
0.06
0.08
0.1
TIME – SEC
UNFILTERED
CLASS 60

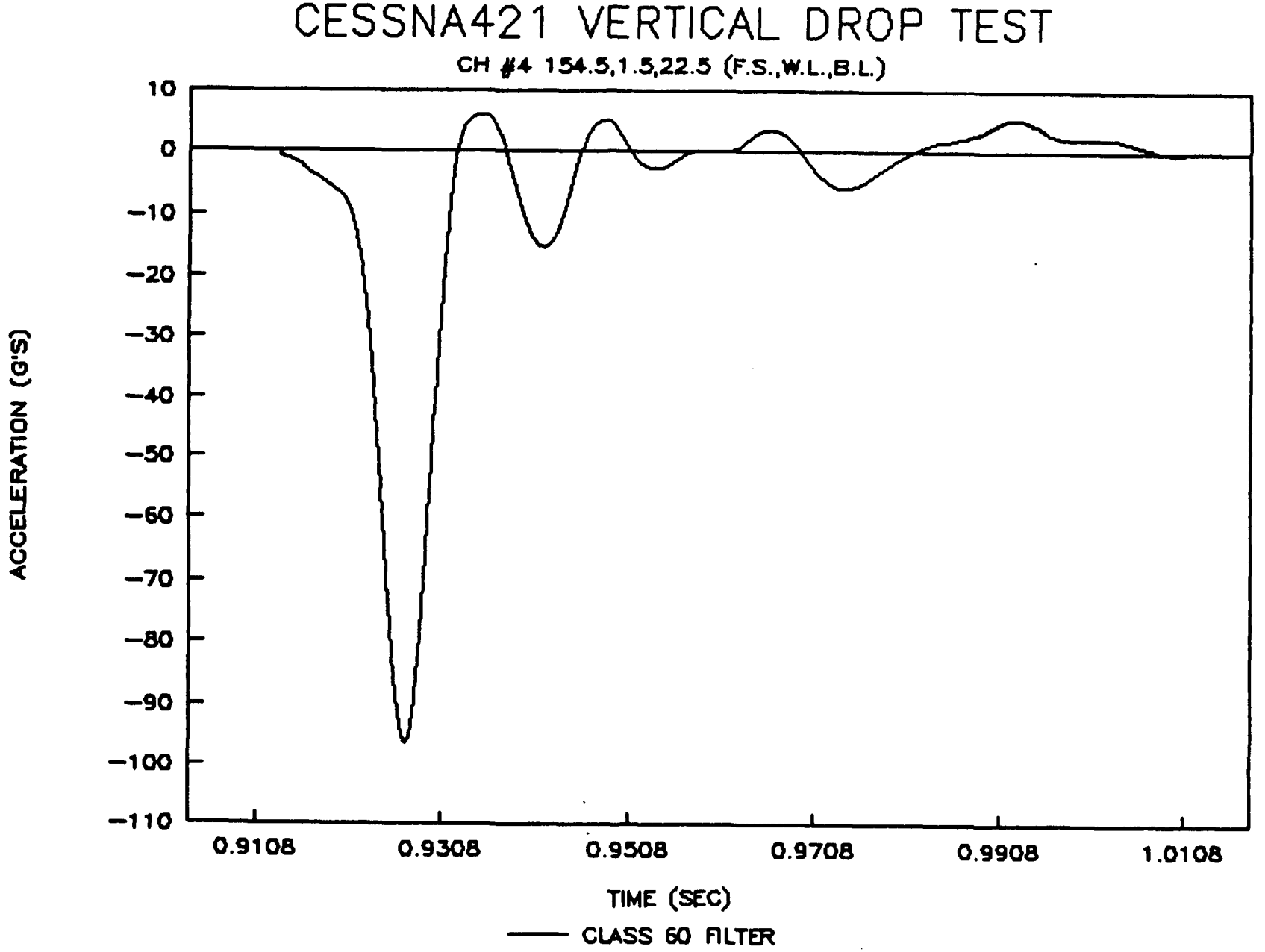

CESSNA 421B DROP TEST
CHANNEL 28 STANDARD SEAT BS 212.87
PELVIC VERTICAL ACCELERATION – G's
20
10
0
-10
-20
-30
-40
-50
0
0.02
0.04
0.06
0.08
0.1
TIME – SEC
UNFILTERED
CLASS 60

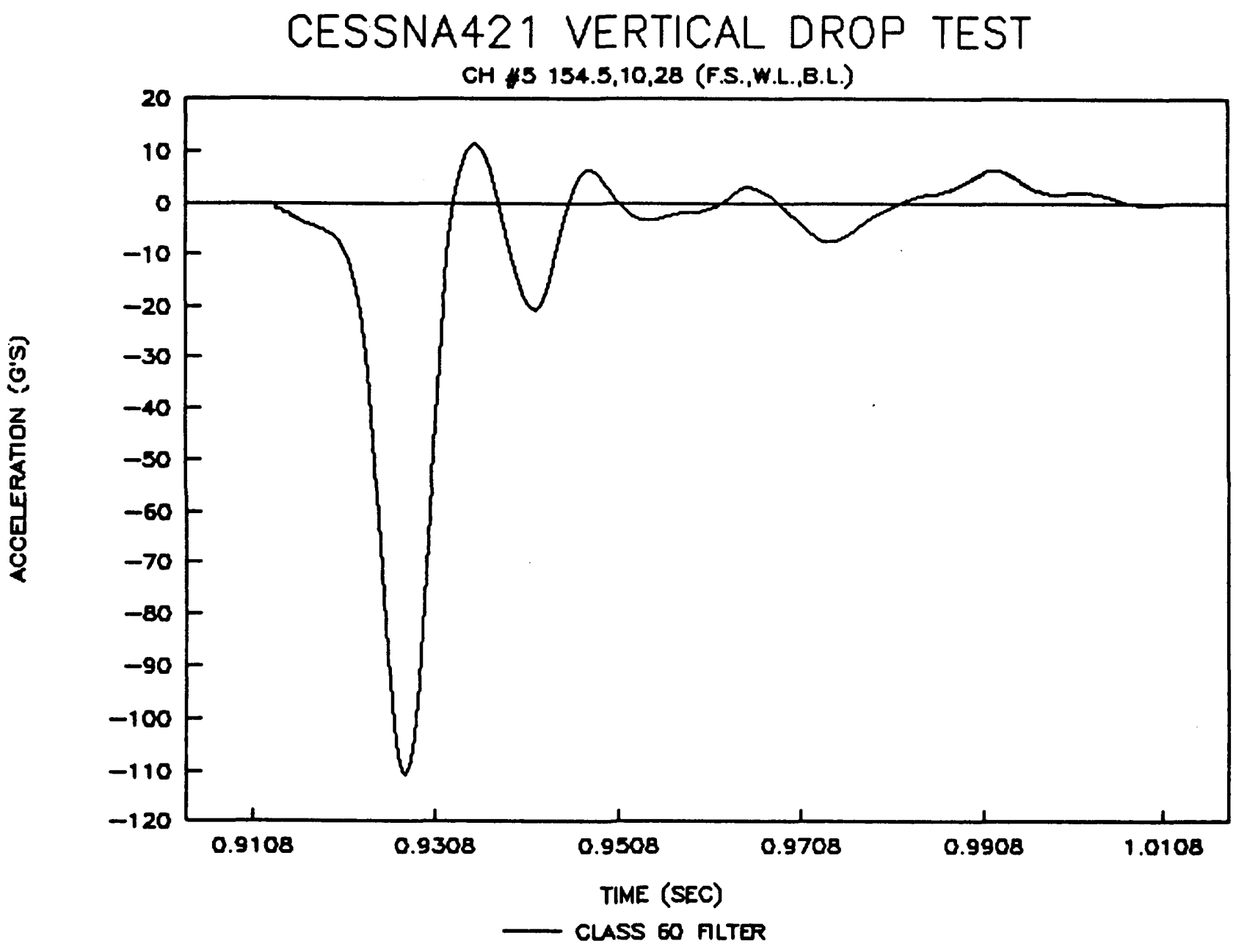

CESSNA 421B DROP TEST
CHANNEL 29 REAR SEAT DUMMY BS 289.94
PELVIC VERTICAL ACCELERATION – G's
0
-10
-20
-30
-40
-50
-60
-70
-80
0
0.02
0.04
0.06
0.08
0.1
TIME – SEC
UNFILTERED
CLASS 60

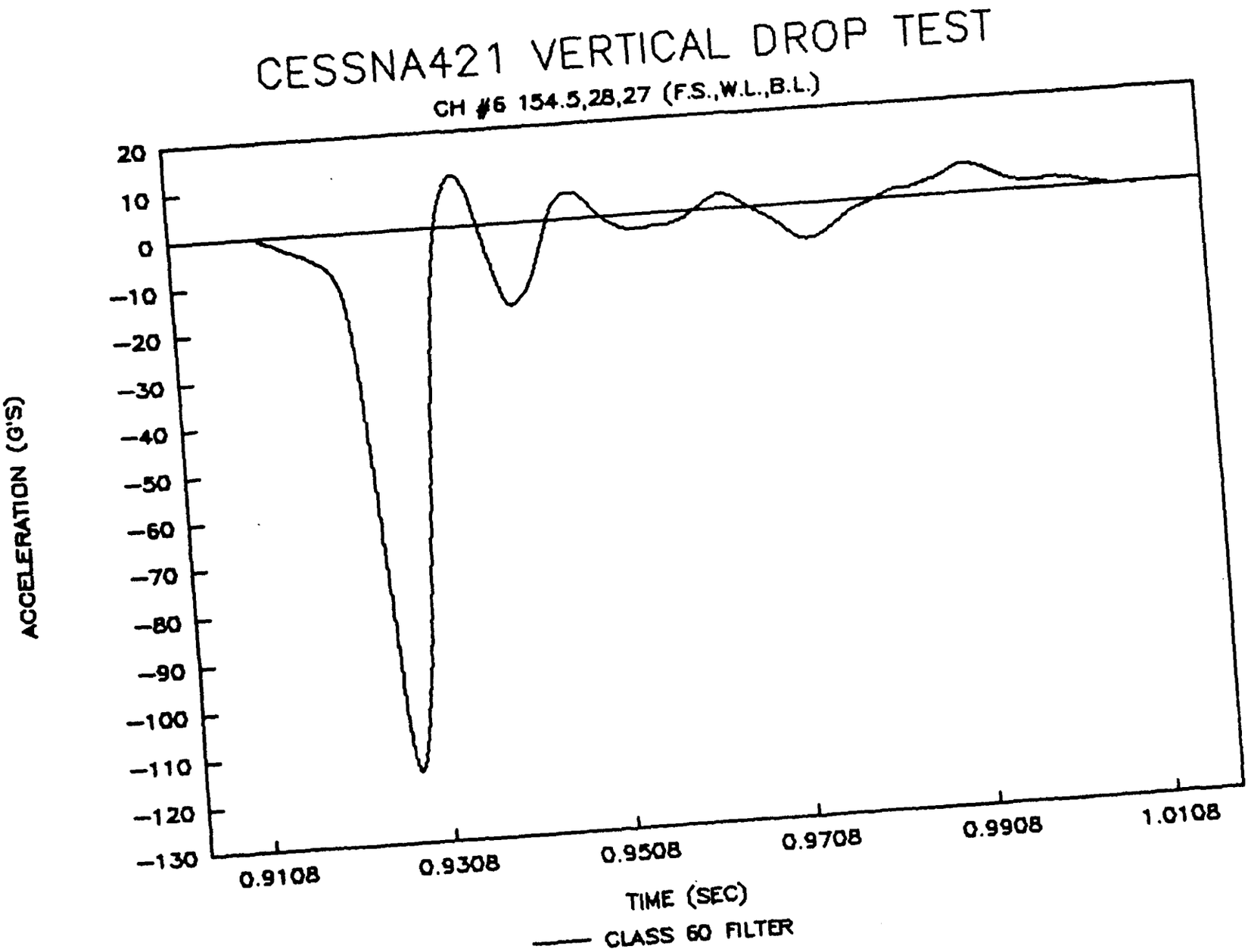

CESSNA421 VERTICAL DROP TEST
CH #1 154.5,28,-27 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

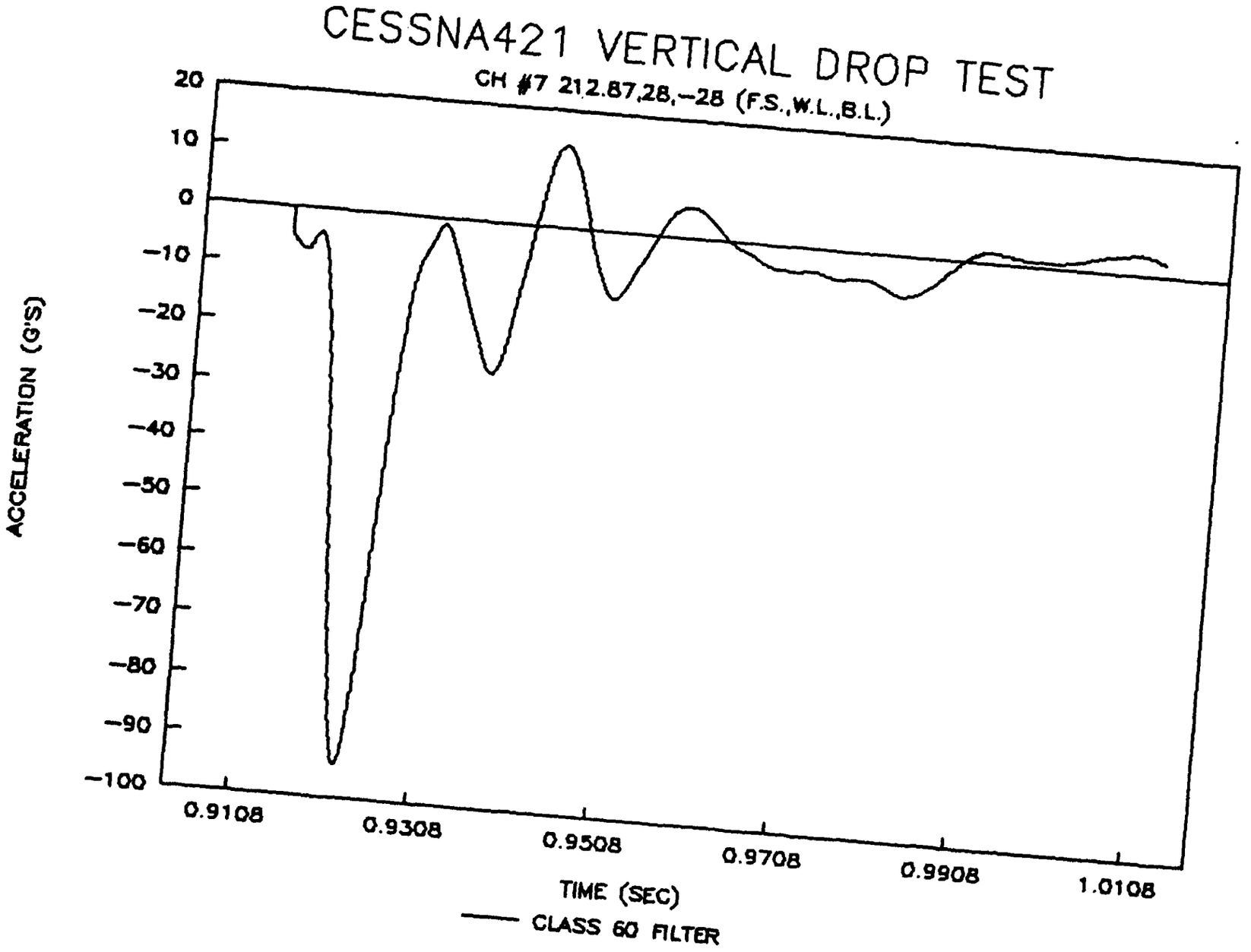

CESSNA421 VERTICAL DROP TEST
CH #2 154.5,10,-28 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

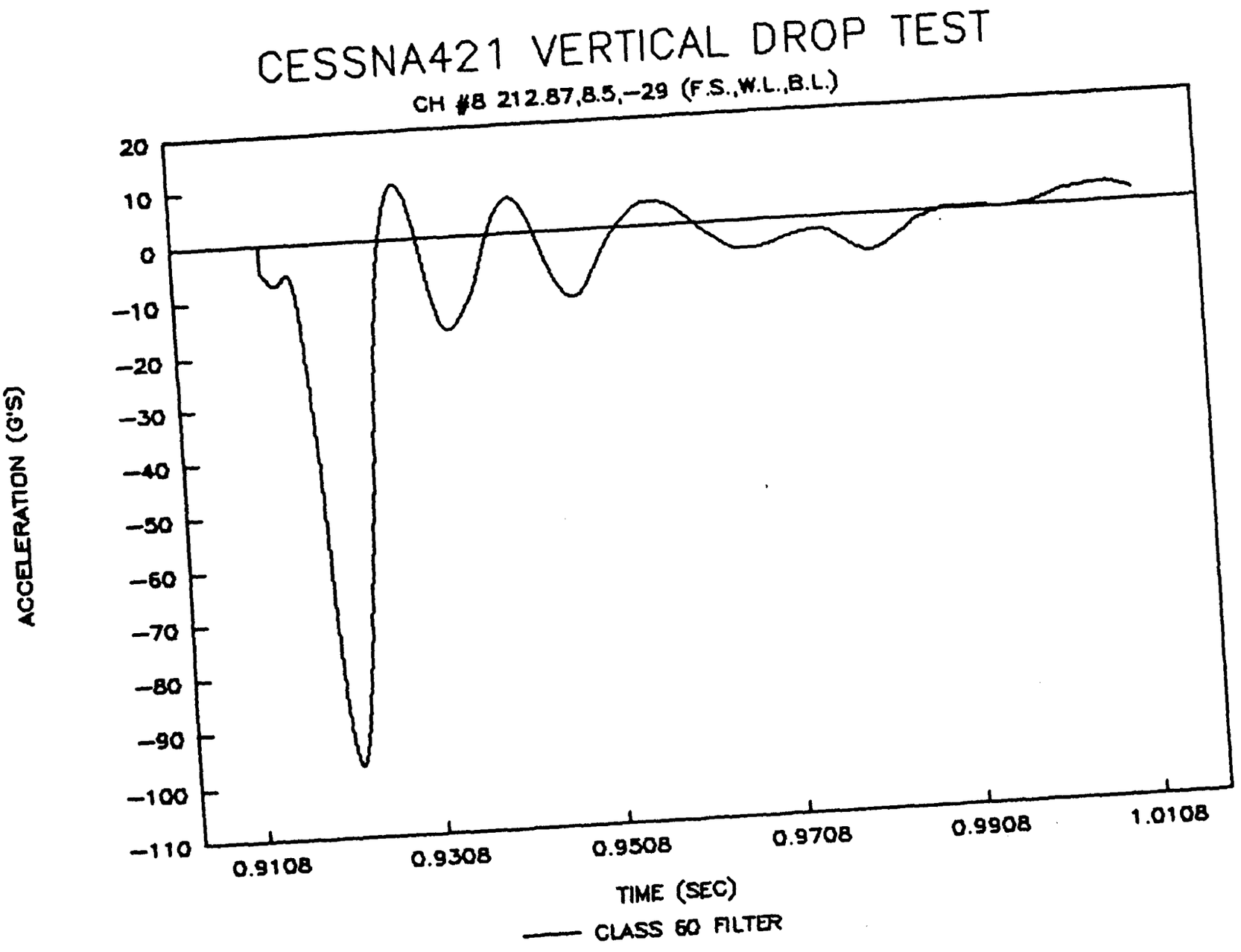

CESSNA421 VERTICAL DROP TEST
CH #3 154.5,1.5,-22.5 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

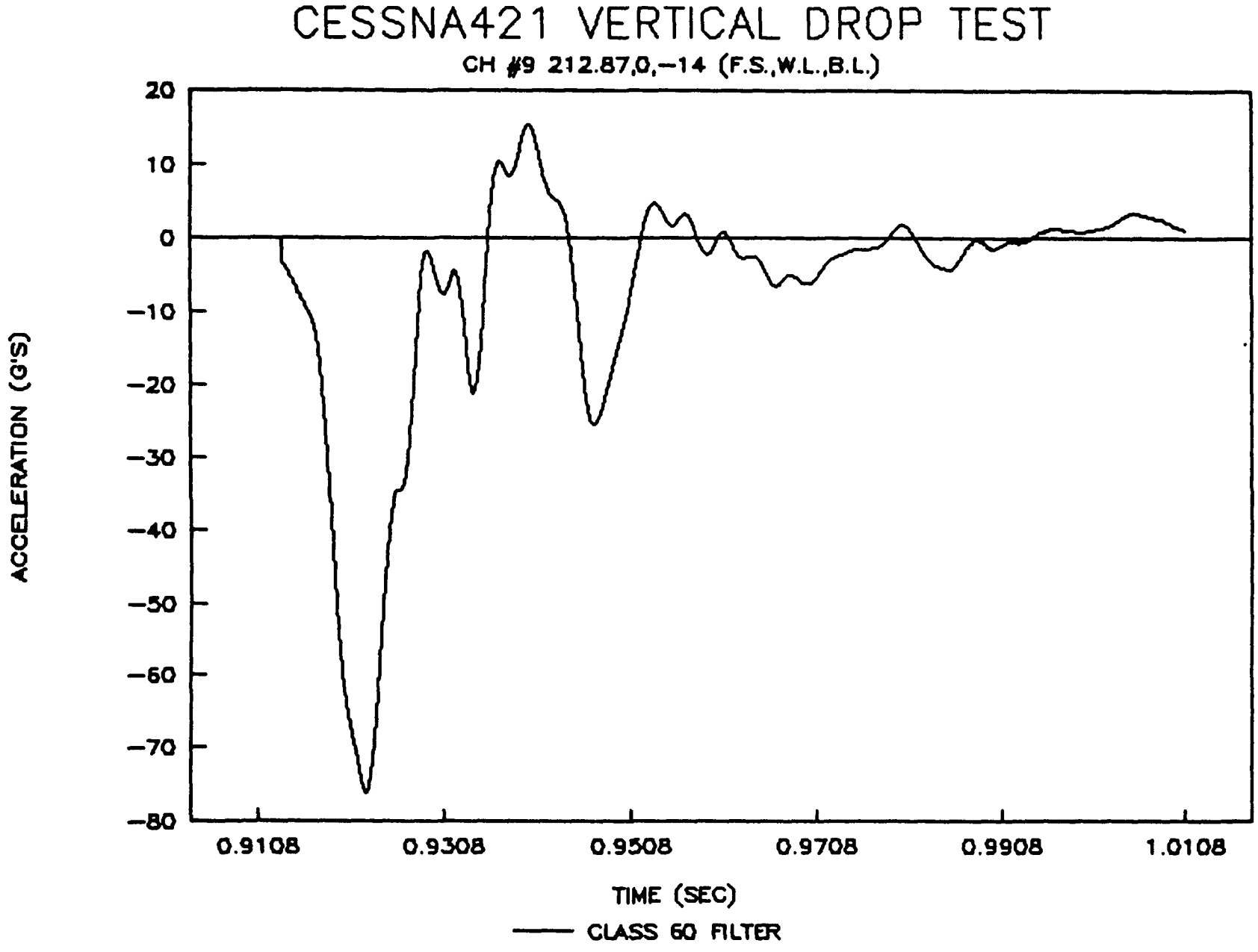

CESSNA421 VERTICAL DROP TEST
CH #4 154.5,1.5,22.5 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

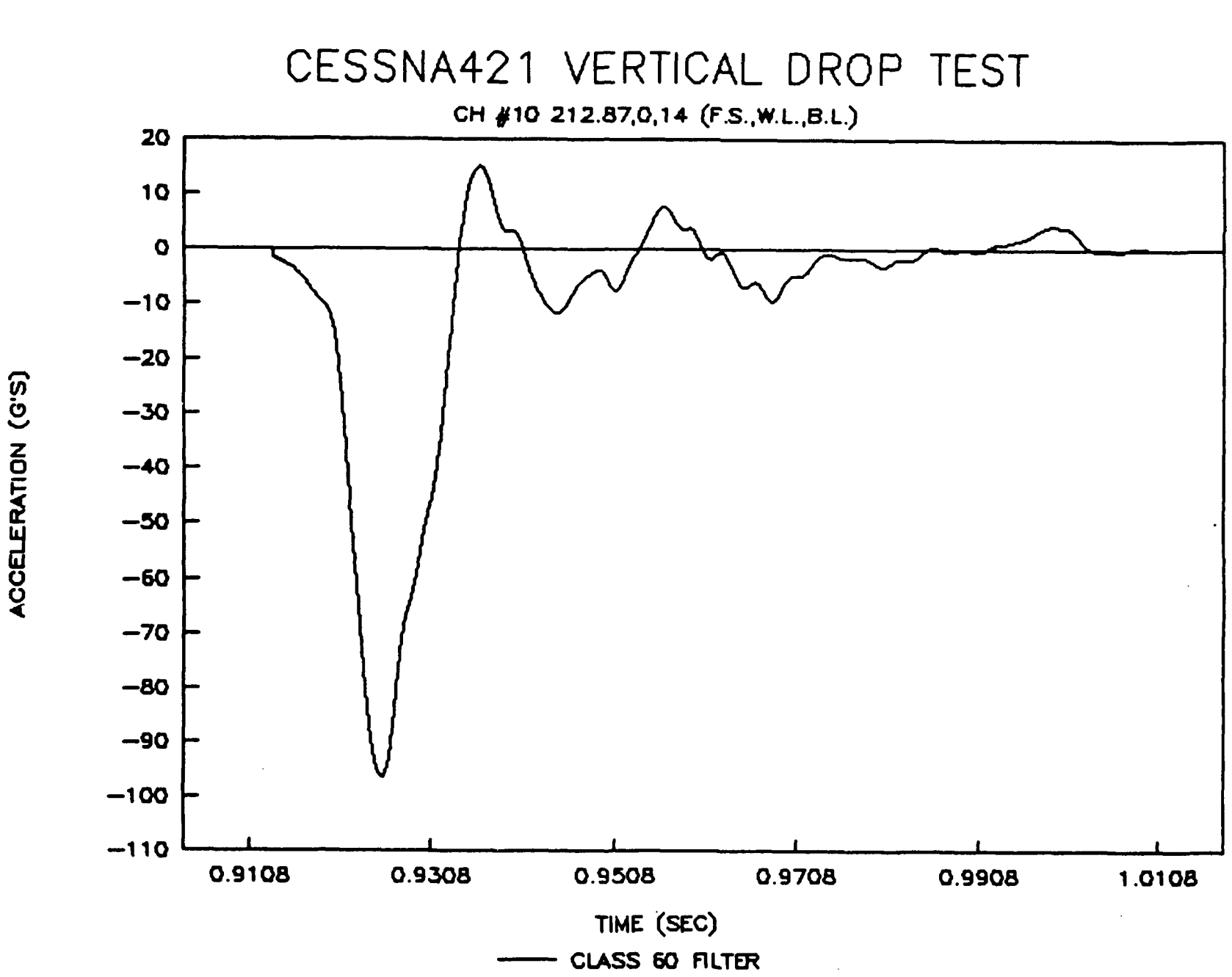

CESSNA421 VERTICAL DROP TEST
CH #5 154.5,10,28 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

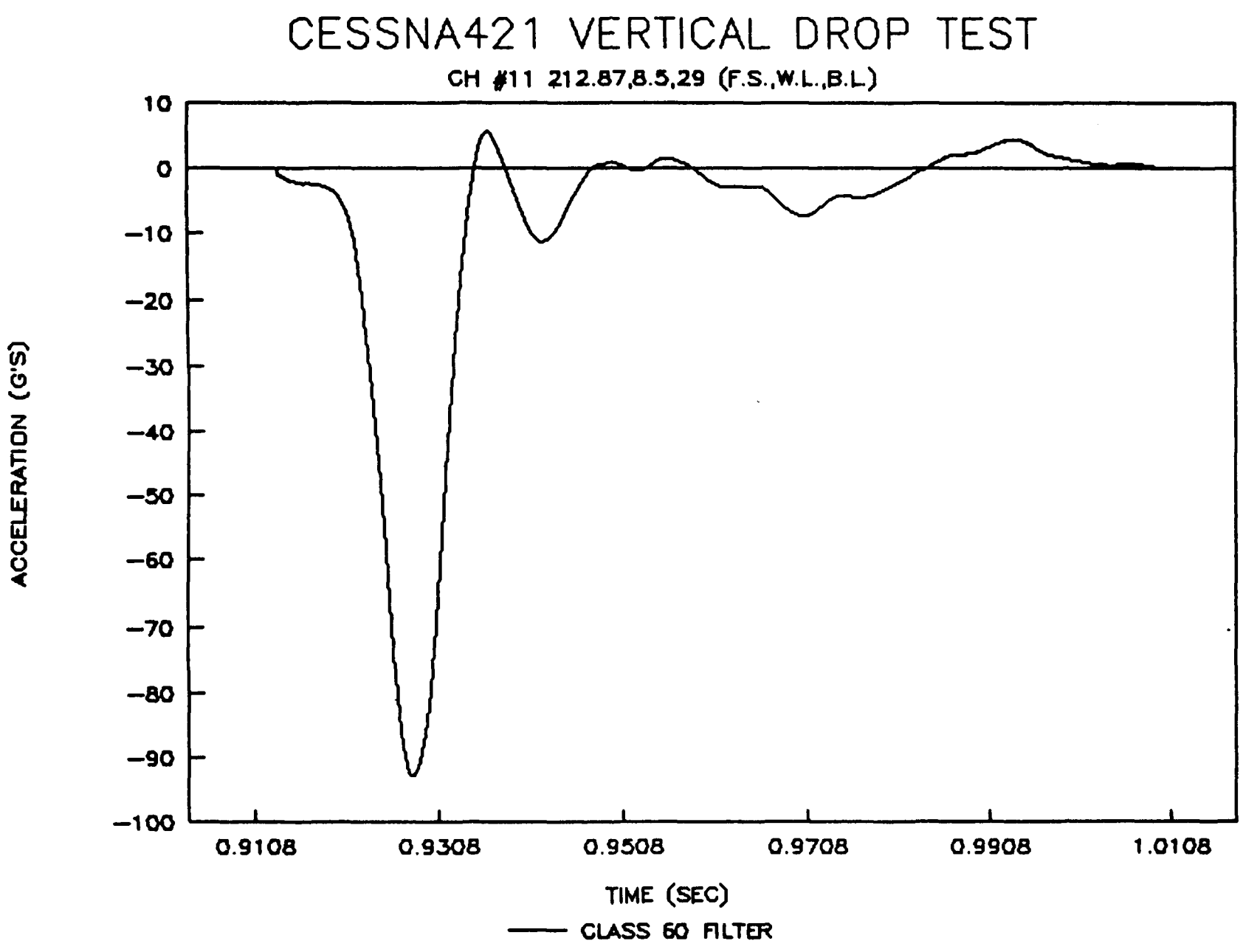

CESSNA421 VERTICAL DROP TEST
CH #6 154.5,28,27 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

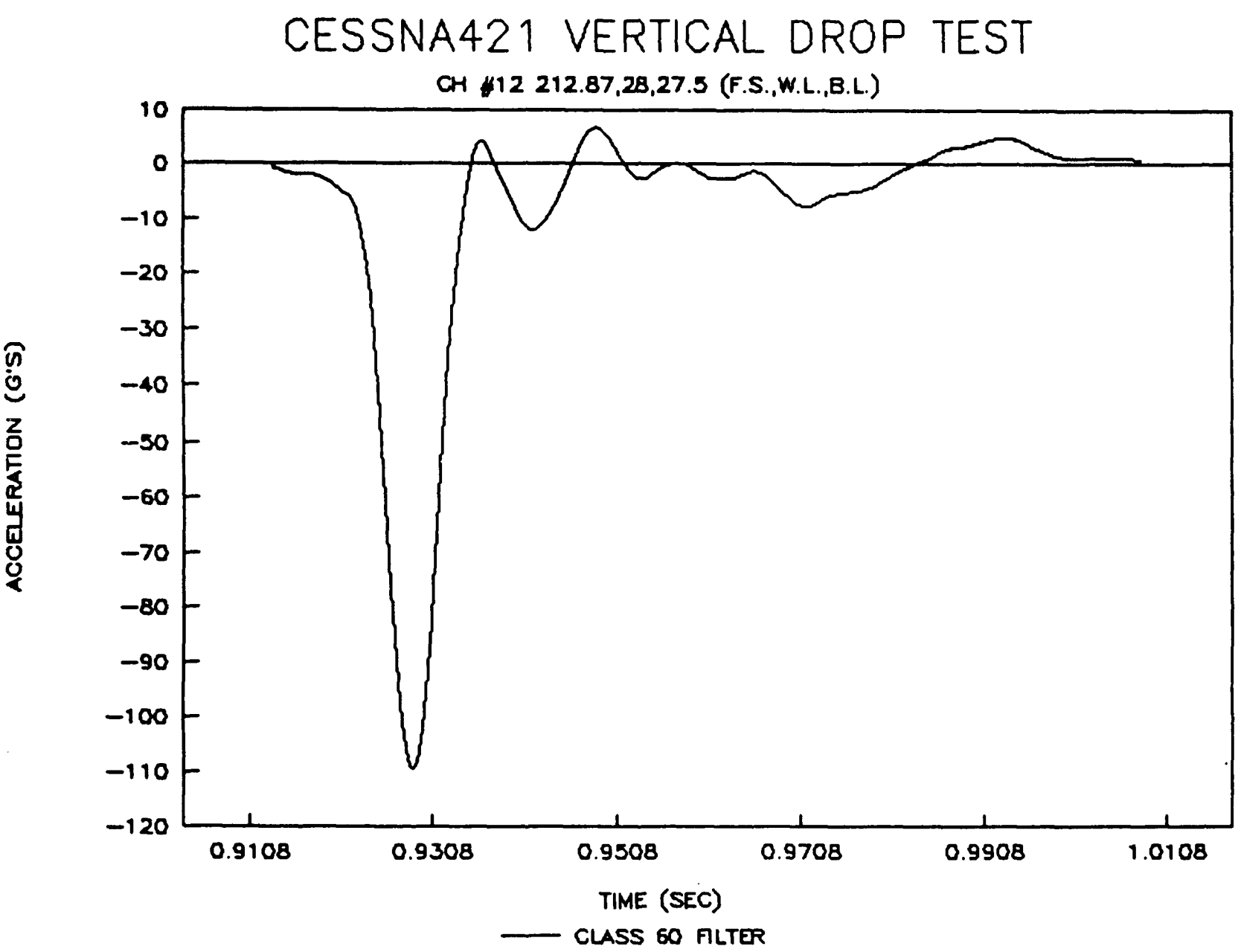

CESSNA421 VERTICAL DROP TEST
CH #7 212.87,28,-28 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

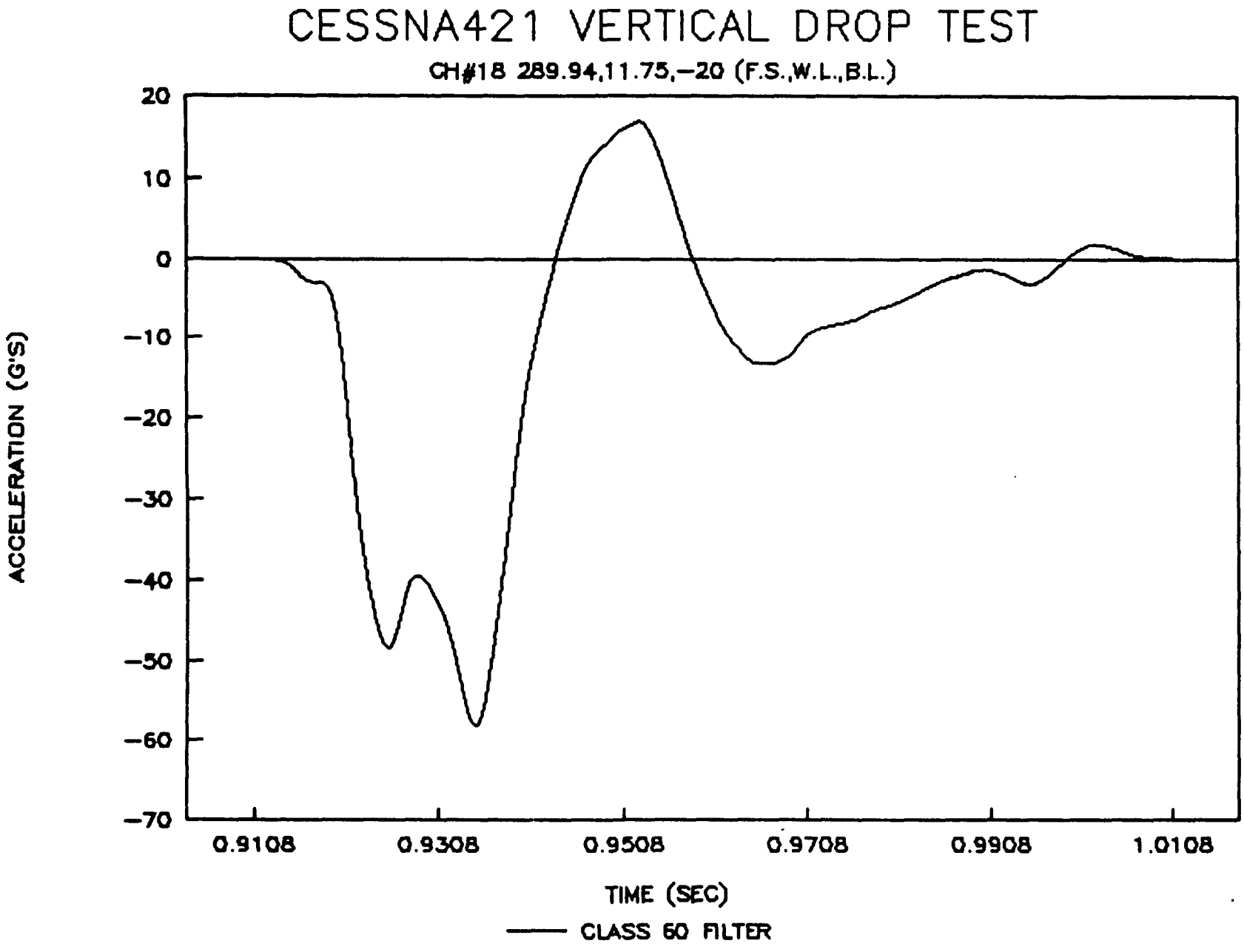

CESSNA421 VERTICAL DROP TEST
CH #8 212.87,8.5,-29 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

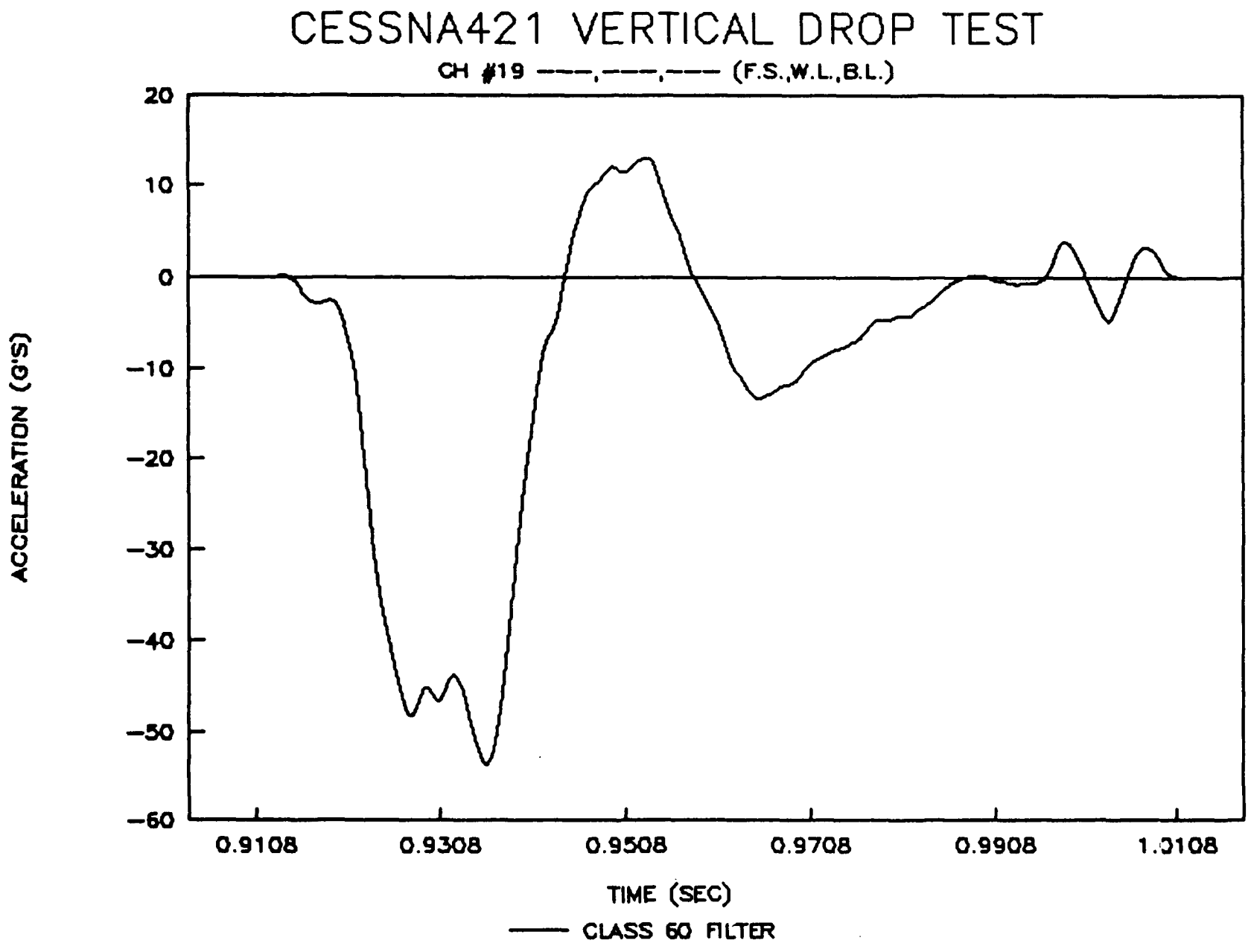

CESSNA421 VERTICAL DROP TEST
CH #9 212.87,0,-14 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

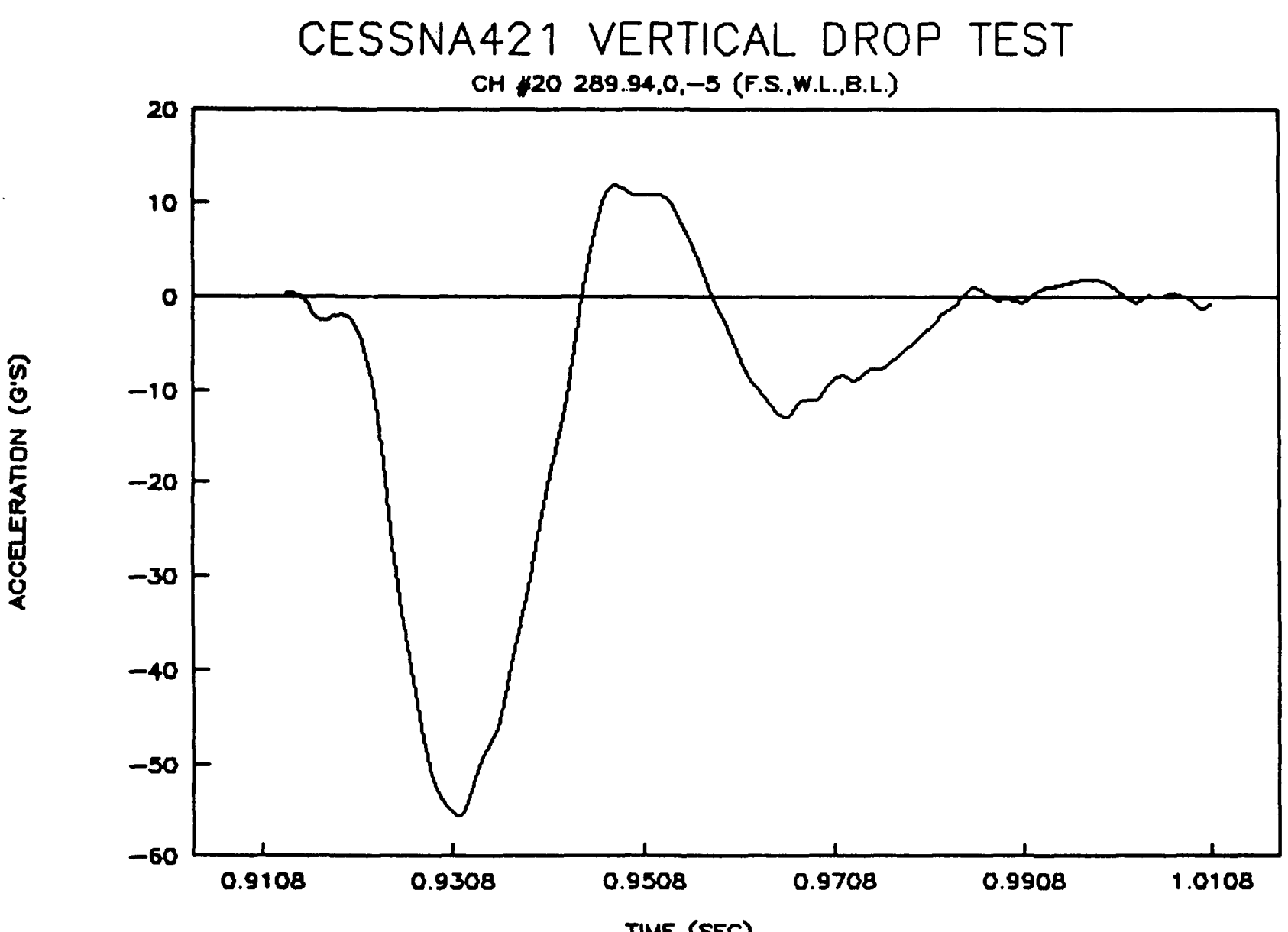

CESSNA421 VERTICAL DROP TEST
CH #10 212.87,0,14 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

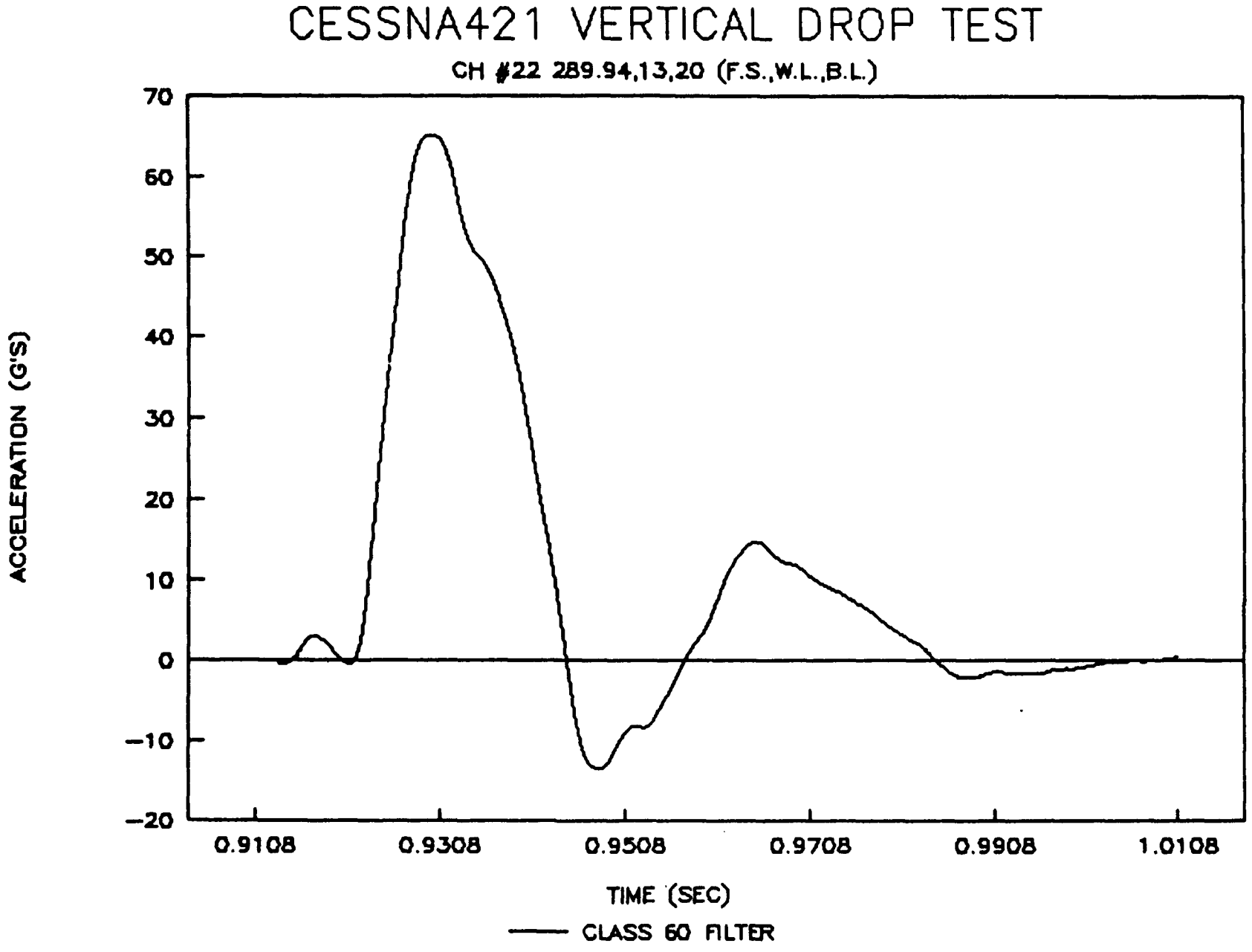

CESSNA421 VERTICAL DROP TEST
CH #11 212.87,8.5,29 (F.S.,W.L.,B.L)
ACCELERATION (G'S)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

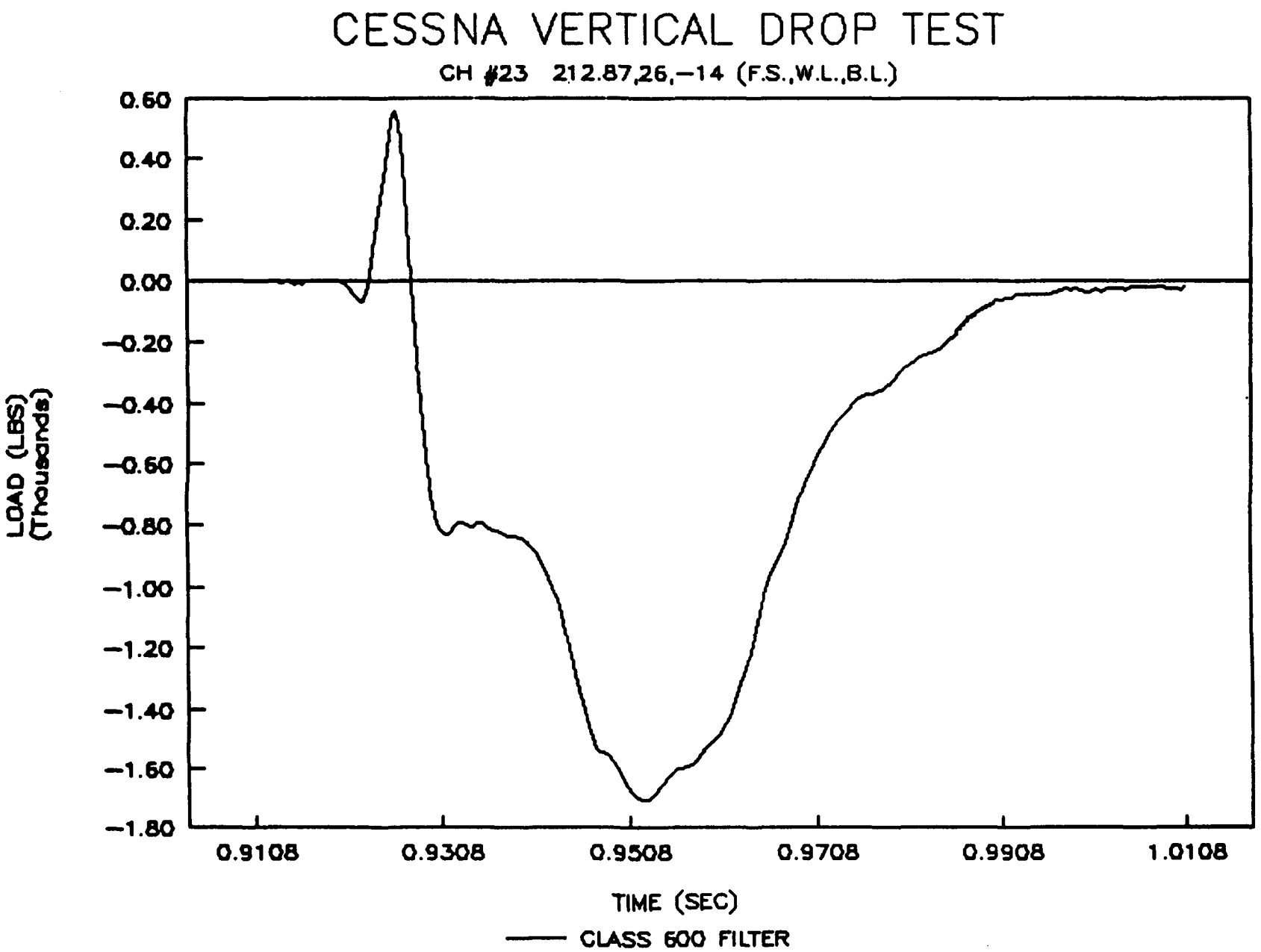

CESSNA421 VERTICAL DROP TEST
CH #12 212.87,28,27.5 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

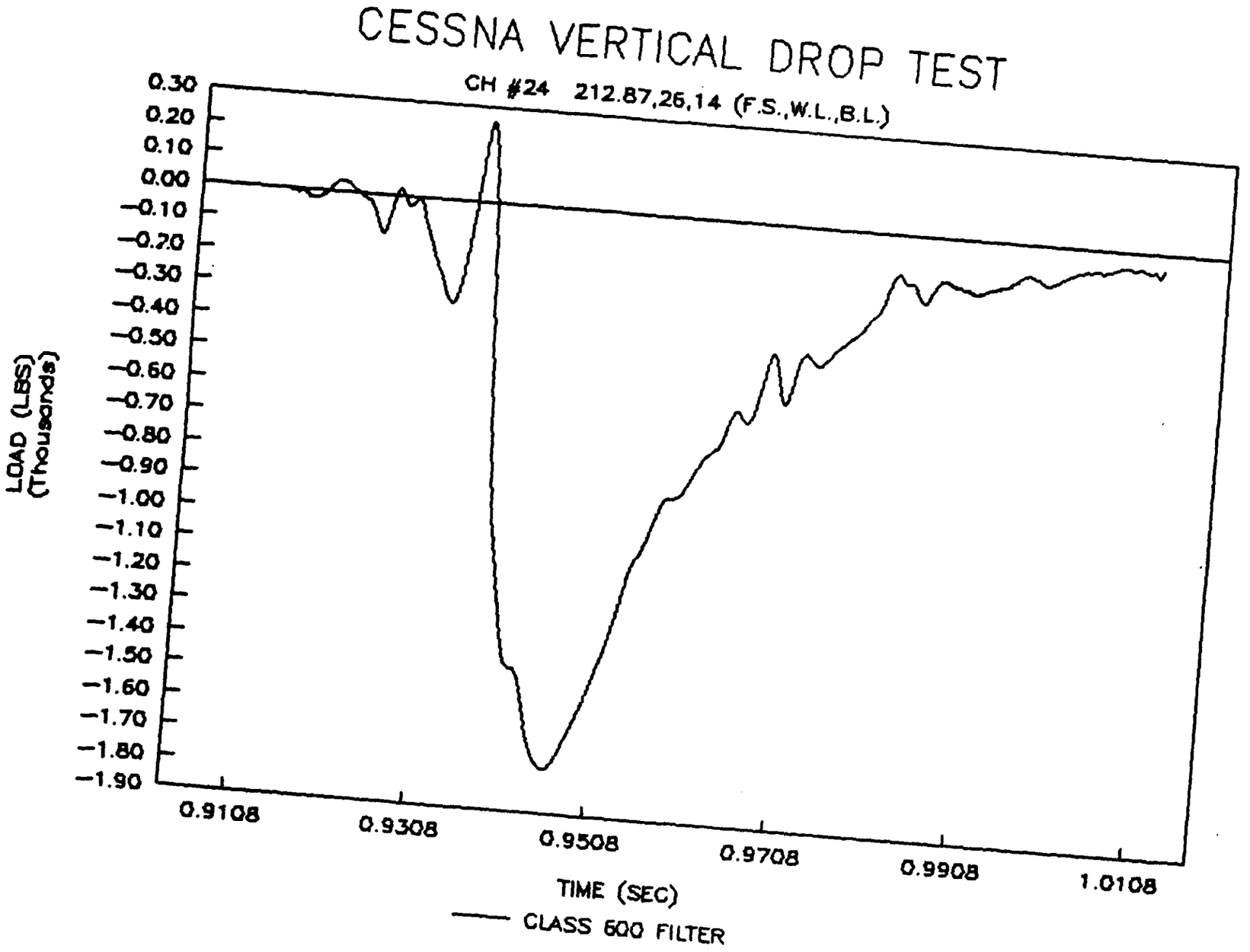

CESSNA421 VERTICAL DROP TEST
CH#18 289.94,11.75,-20 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

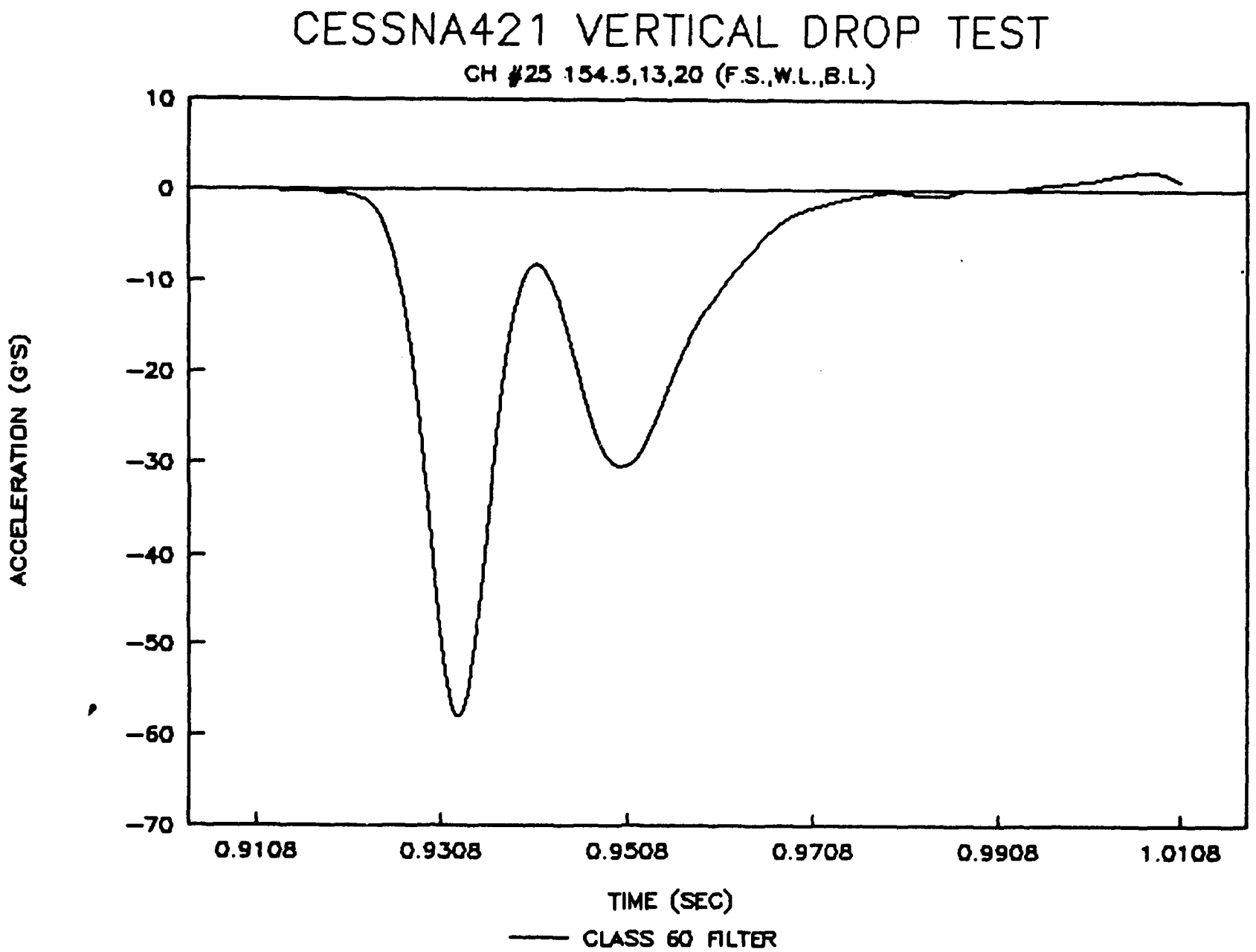

CESSNA421 VERTICAL DROP TEST
CH #19 ———,———,——— (F.S.,W.L.,B.L.)
20
10
0
-10
-20
-30
-40
-50
-60
ACCELERATION (G'S)
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
——— CLASS 60 FILTER

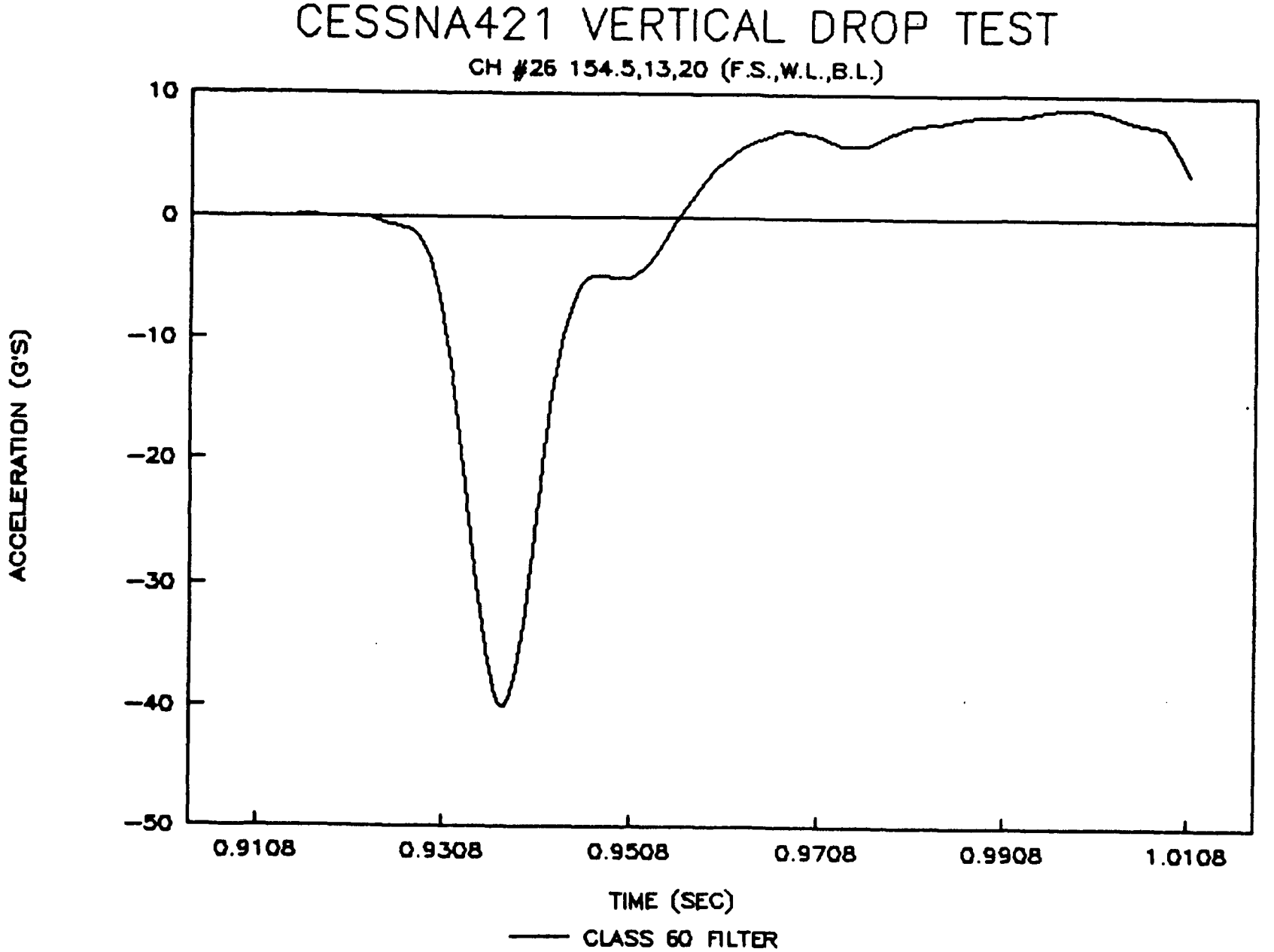

CESSNA421 VERTICAL DROP TEST
CH #20 289.94,0,-5 (F.S.,W.L.,B.L.)
20
10
0
-10
-20
-30
-40
-50
-60
ACCELERATION (G'S)
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

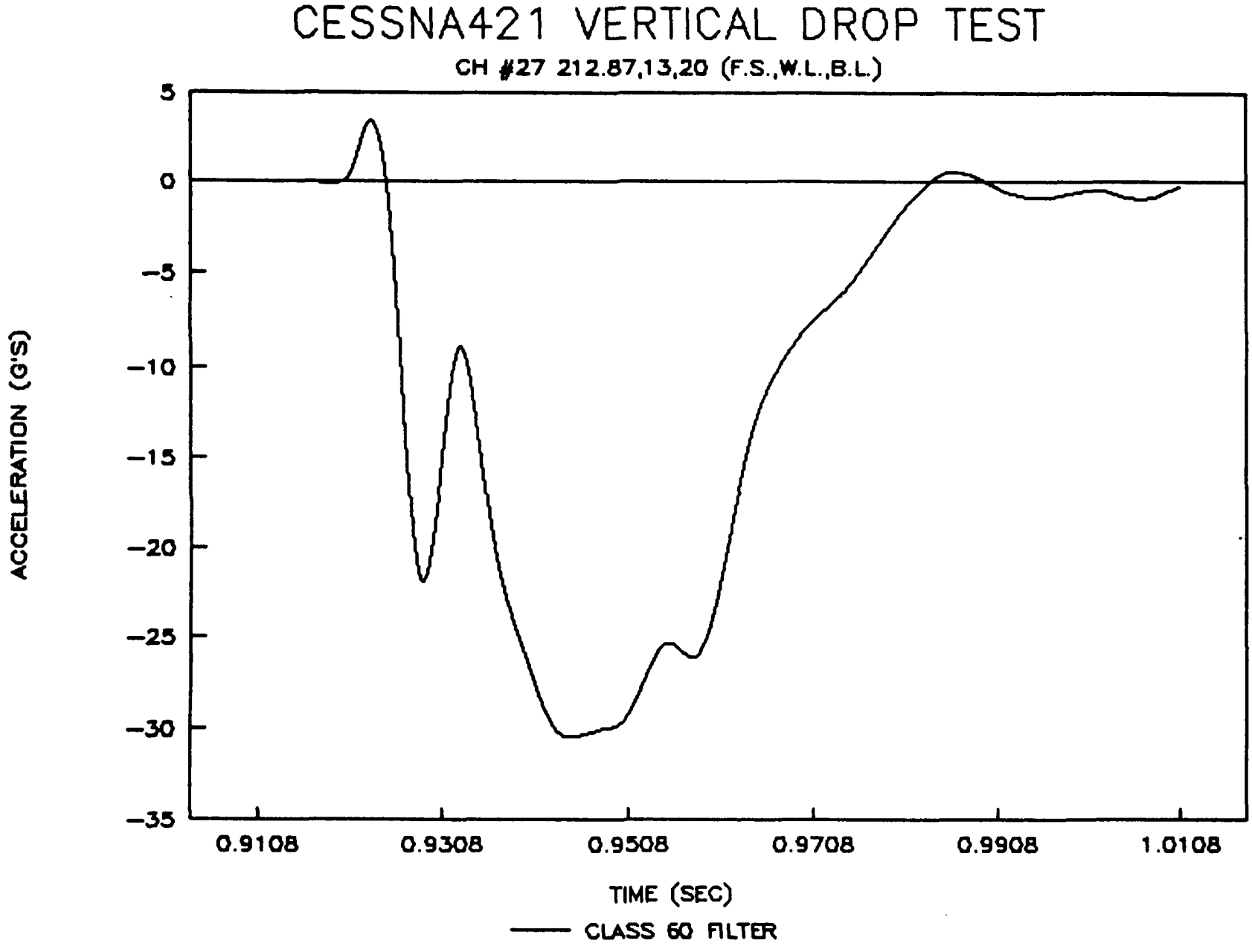

CESSNA421 VERTICAL DROP TEST
CH #22 289.94,13,20 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
70
60
50
40
30
20
10
0
-10
-20
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

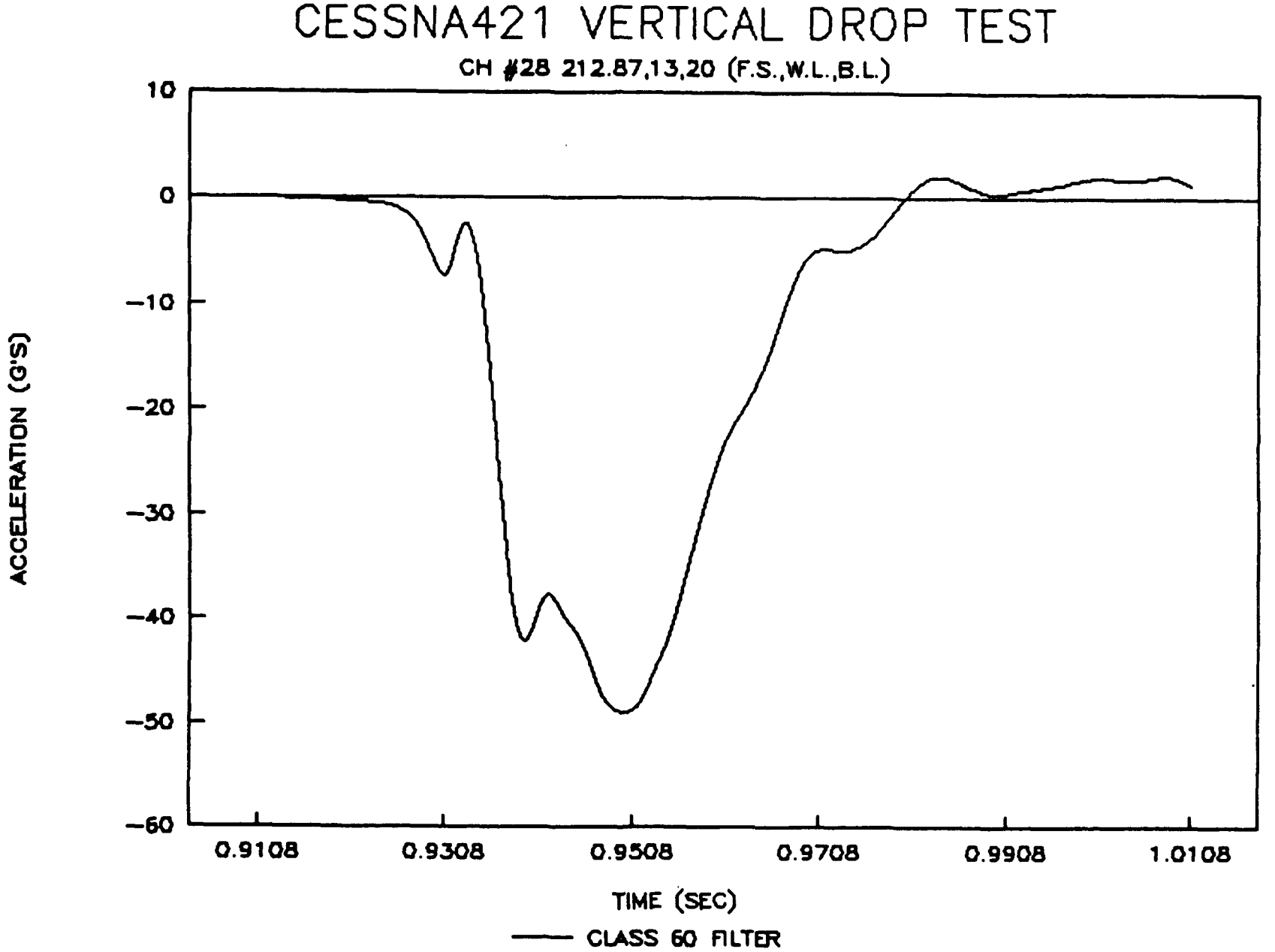

CESSNA VERTICAL DROP TEST
CH #23 212.87,26,-14 (F.S.,W.L.,B.L.)
LOAD (LBS)
(Thousands)
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
-1.20
-1.40
-1.60
-1.80
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 600 FILTER

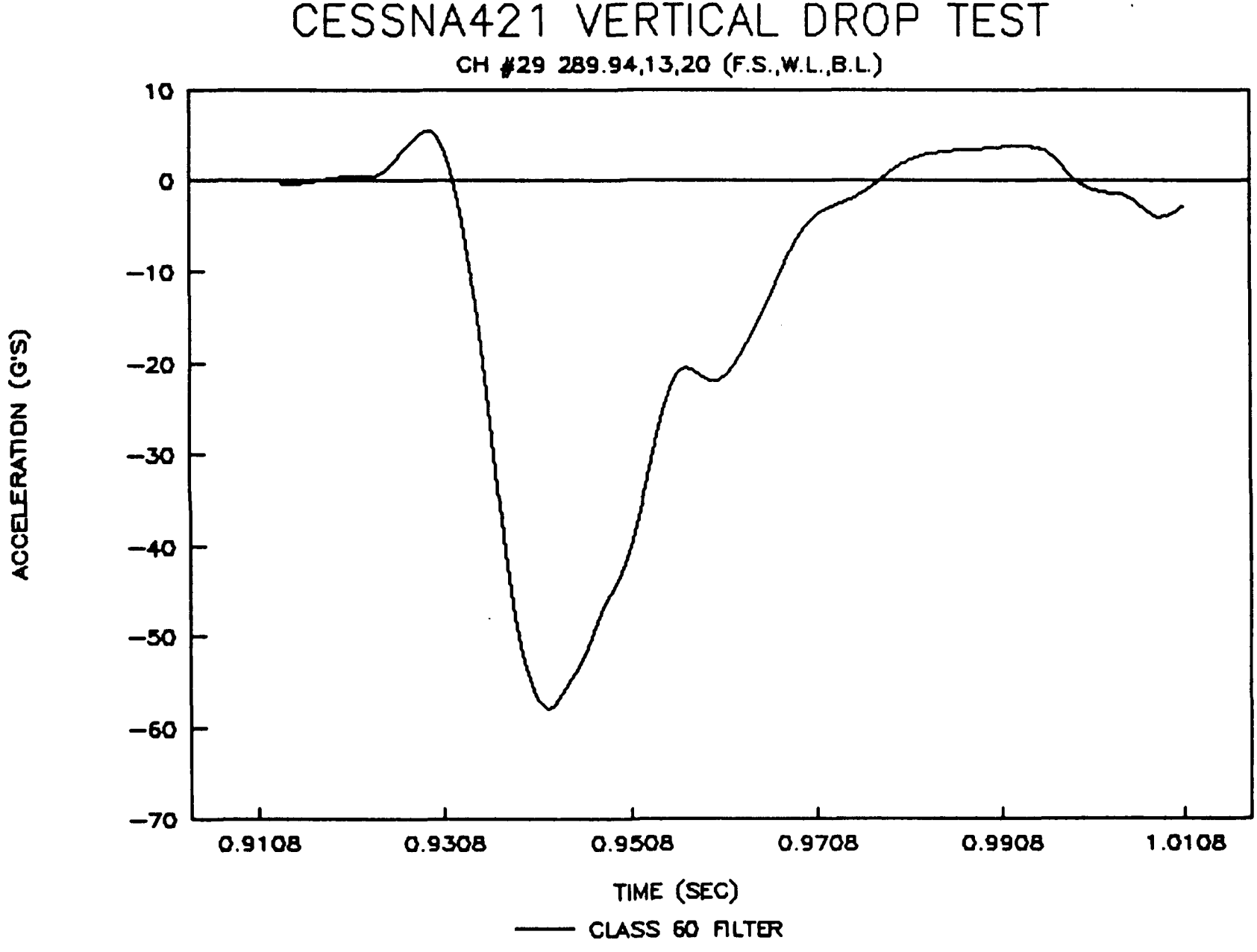

CESSNA VERTICAL DROP TEST
CH #24 212.87,26,14 (F.S.,W.L.,B.L.)
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
-0.60
-0.70
-0.80
-0.90
-1.00
-1.10
-1.20
-1.30
-1.40
-1.50
-1.60
-1.70
-1.80
-1.90
LOAD (LBS)
(Thousands)
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 600 FILTER


CESSNA421 VERTICAL DROP TEST
CH #25 154.5,13,20 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
10
0
-10
-20
-30
-40
-50
-60
-70
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

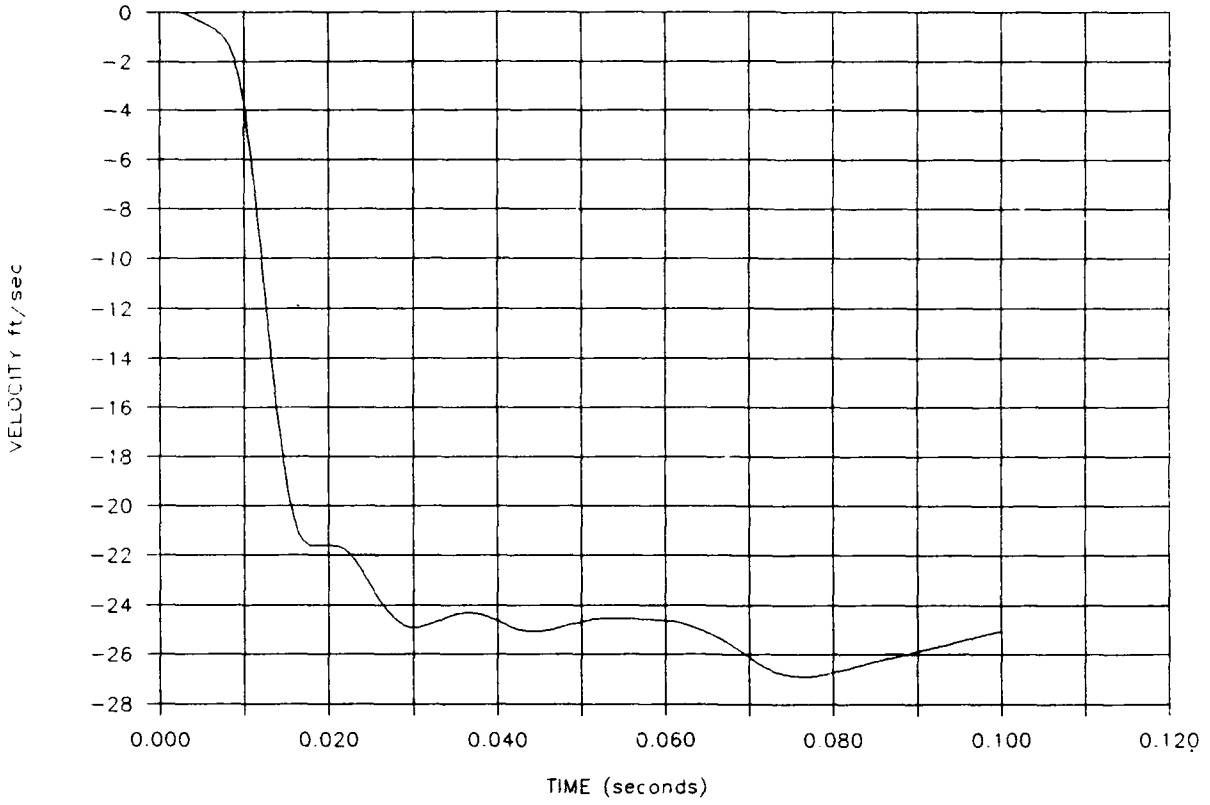

CESSNA421 VERTICAL DROP TEST
CH #26 154.5,13,20 (F.S.,W.L.,B.L.)
10
0
-10
-20
-30
-40
-50
ACCELERATION (G'S)
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER


CESSNA421 VERTICAL DROP TEST
CH #27 212.87,13,20 (F.S.,W.L.,B.L.)
5
0
-5
-10
-15
-20
-25
-30
-35
ACCELERATION (G'S)
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

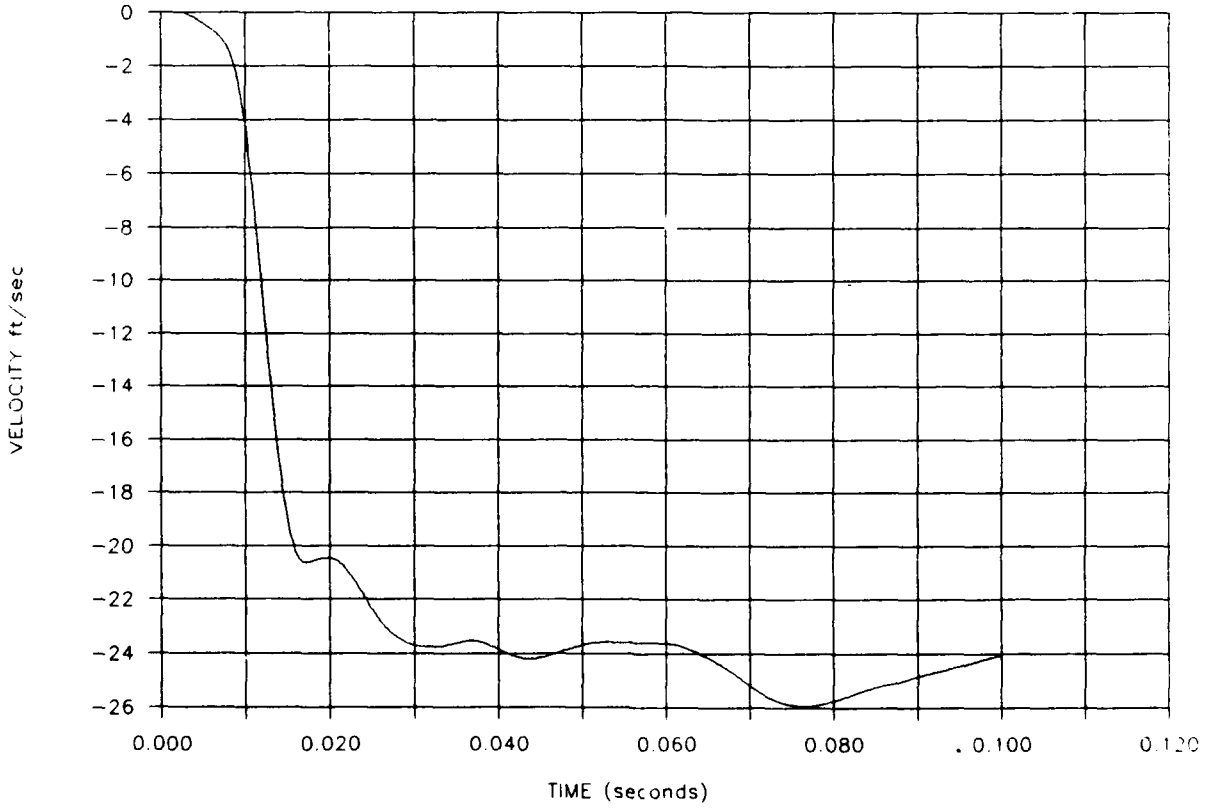

CESSNA421 VERTICAL DROP TEST
CH #28 212.87,13,20 (F.S.,W.L.,B.L.)
10
0
-10
-20
-30
-40
-50
-60
ACCELERATION (G'S)
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER


CESSNA421 VERTICAL DROP TEST
CH #29 289.94,13,20 (F.S.,W.L.,B.L.)
10
0
-10
-20
-30
-40
-50
-60
-70
ACCELERATION (G'S)
0.9108
0.9308
0.9508
0.9708
0.9908
1.0108
TIME (SEC)
CLASS 60 FILTER

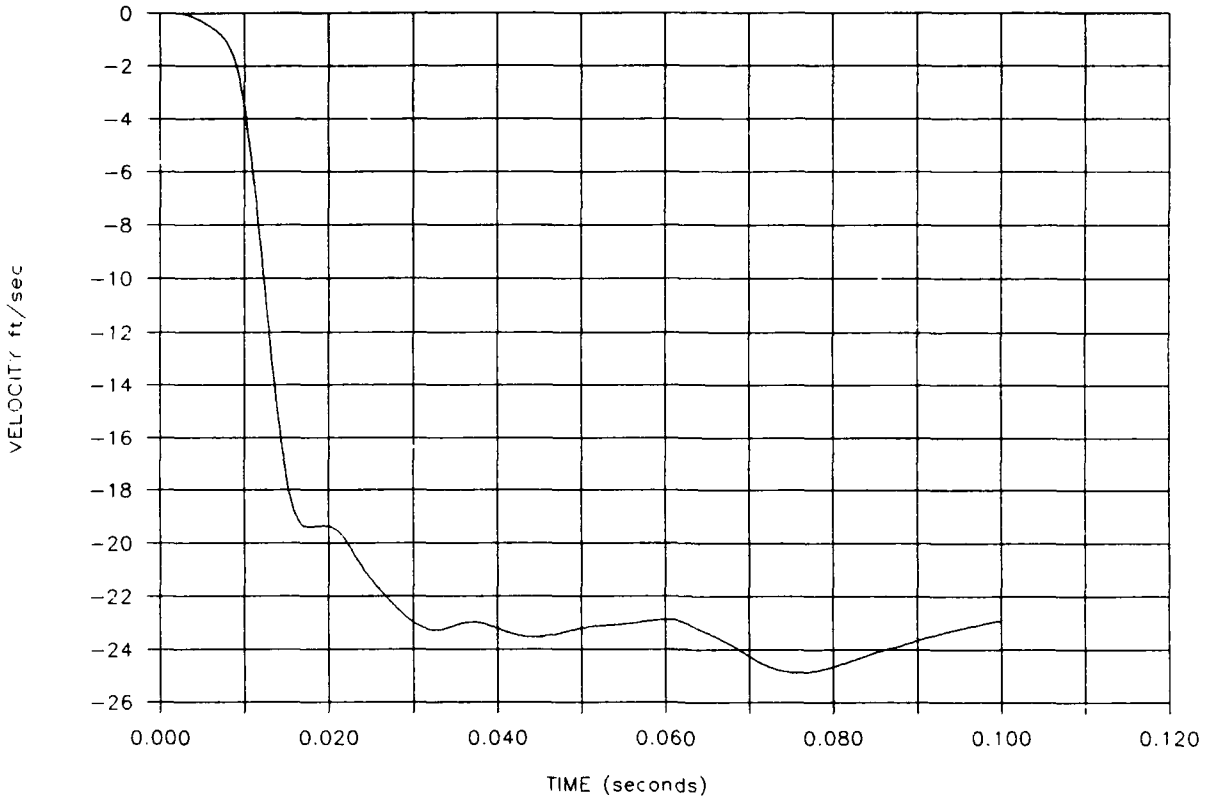
TEST 1, CH 1



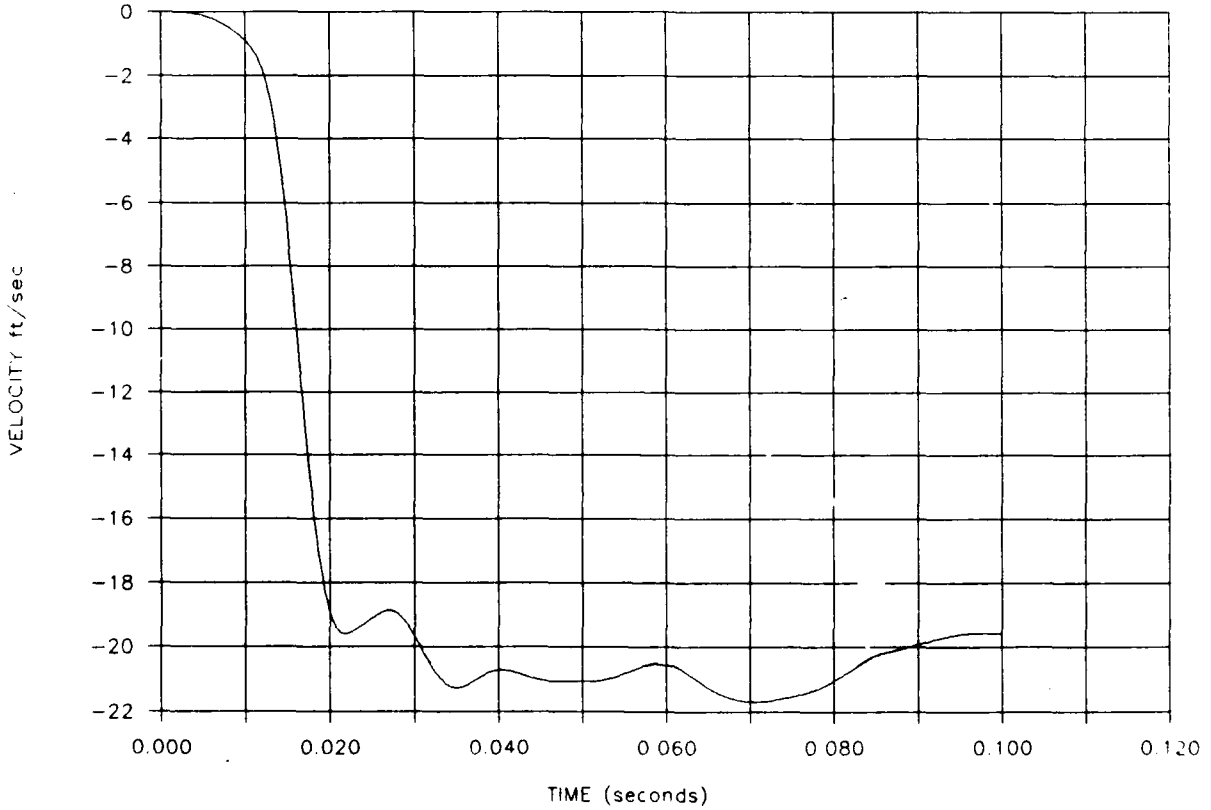
TEST 1, CH 2



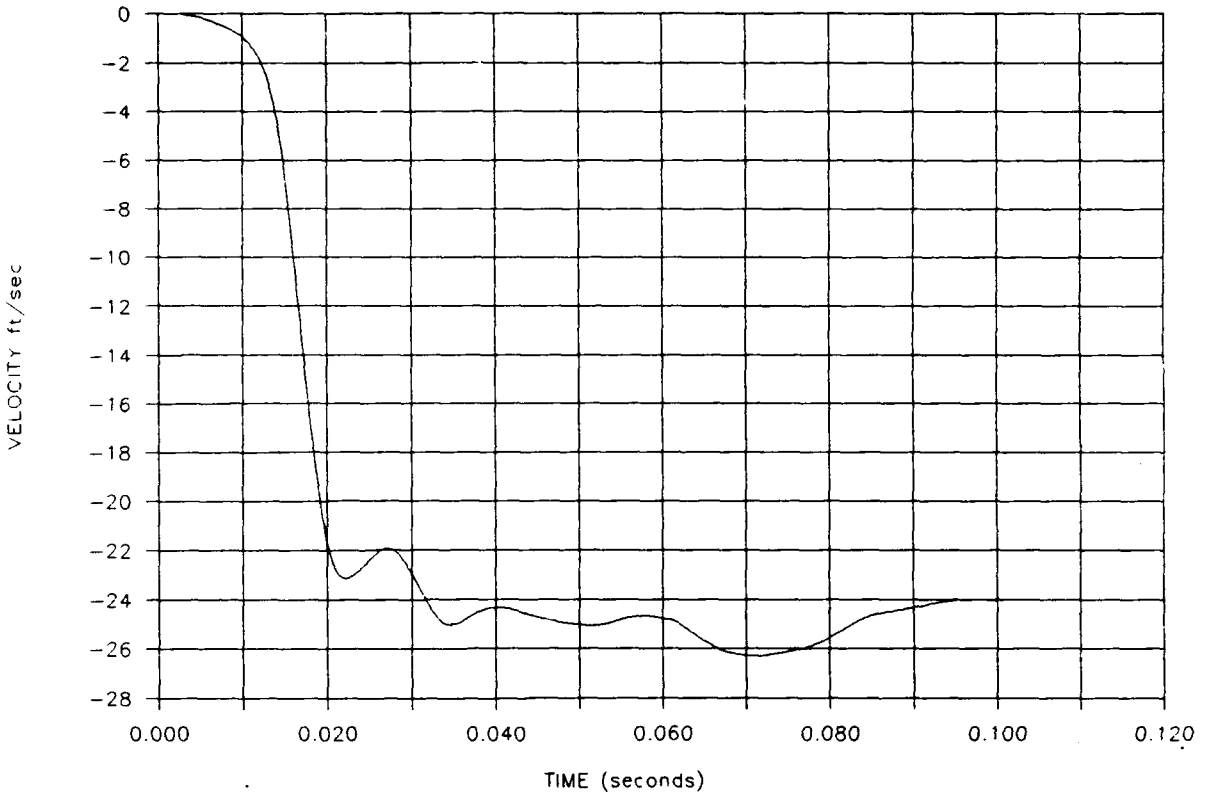
TEST 1, CH 3



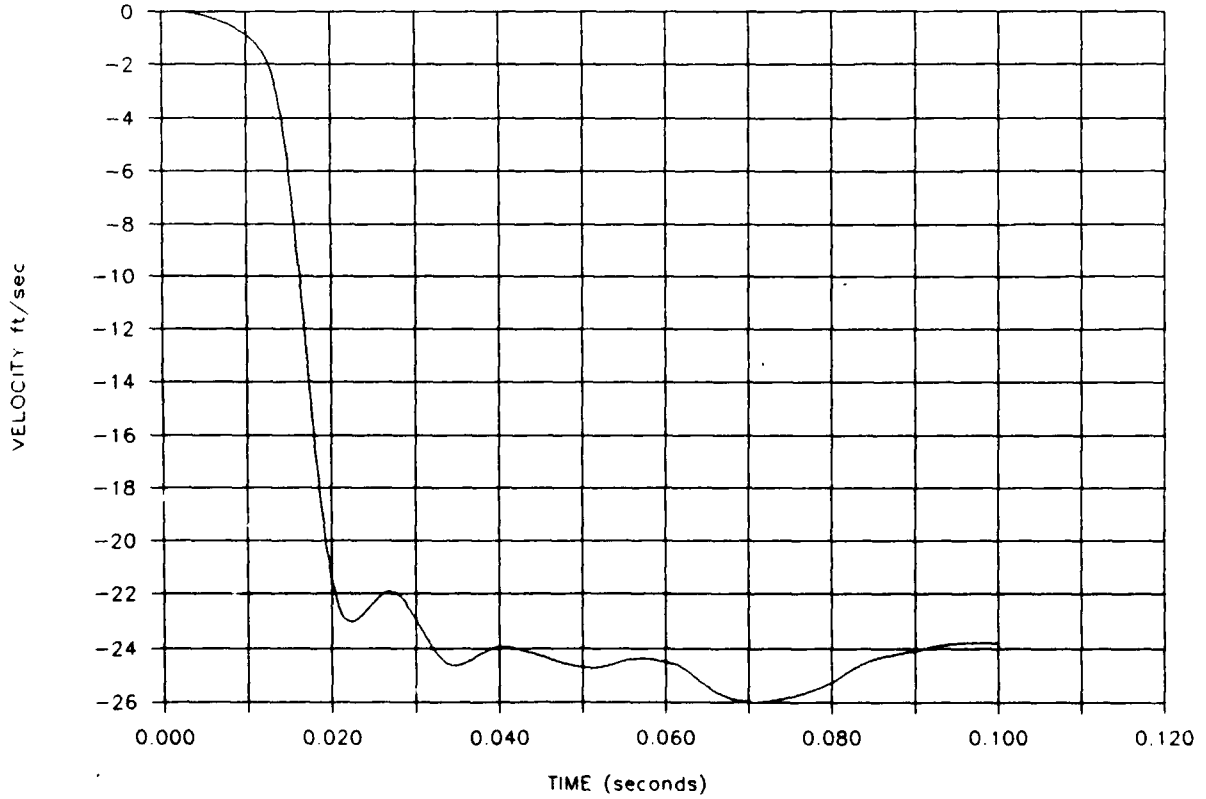
TEST 1, CH 4



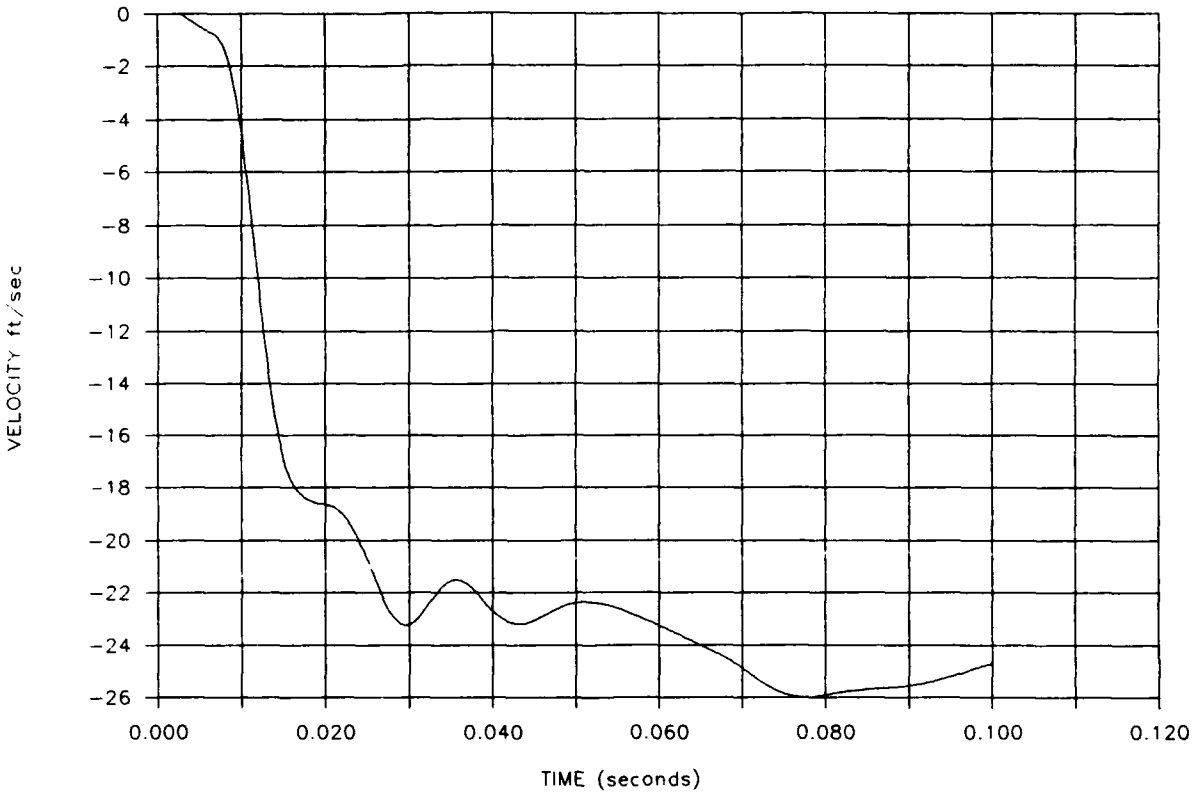
TEST 1, CH 5



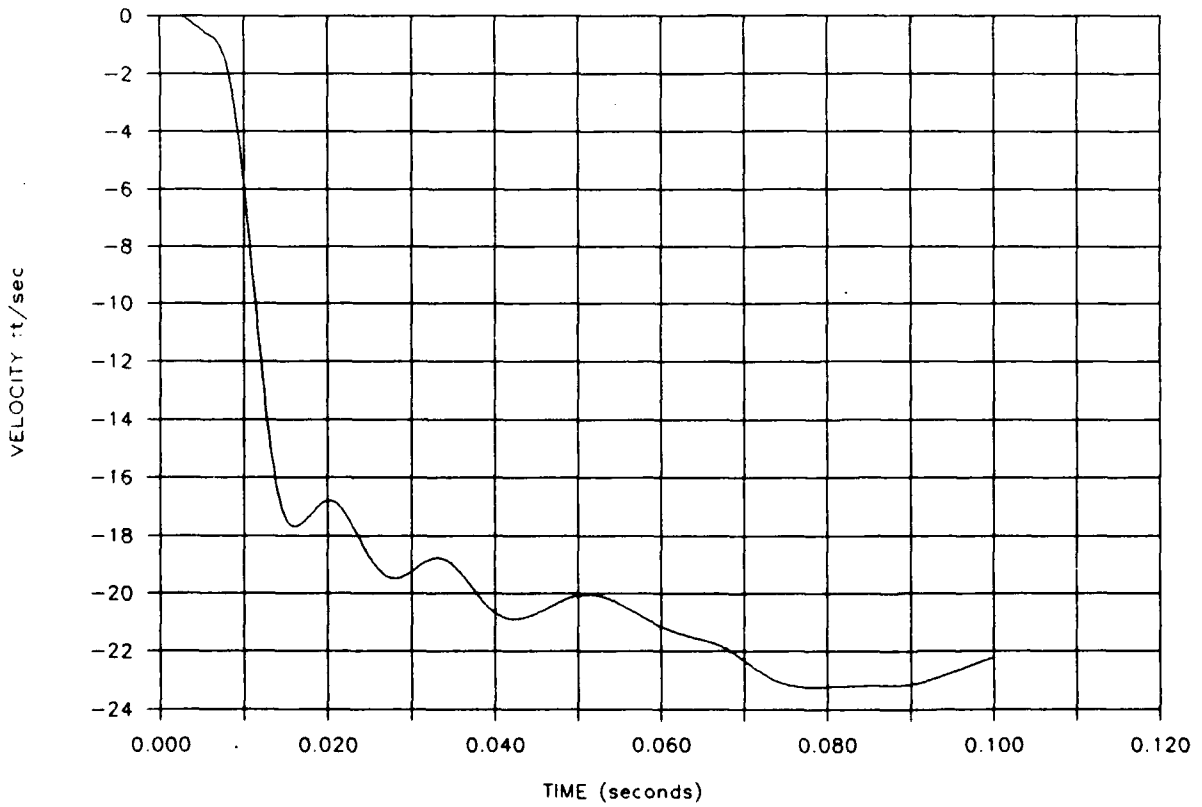
TEST 1, CH 6



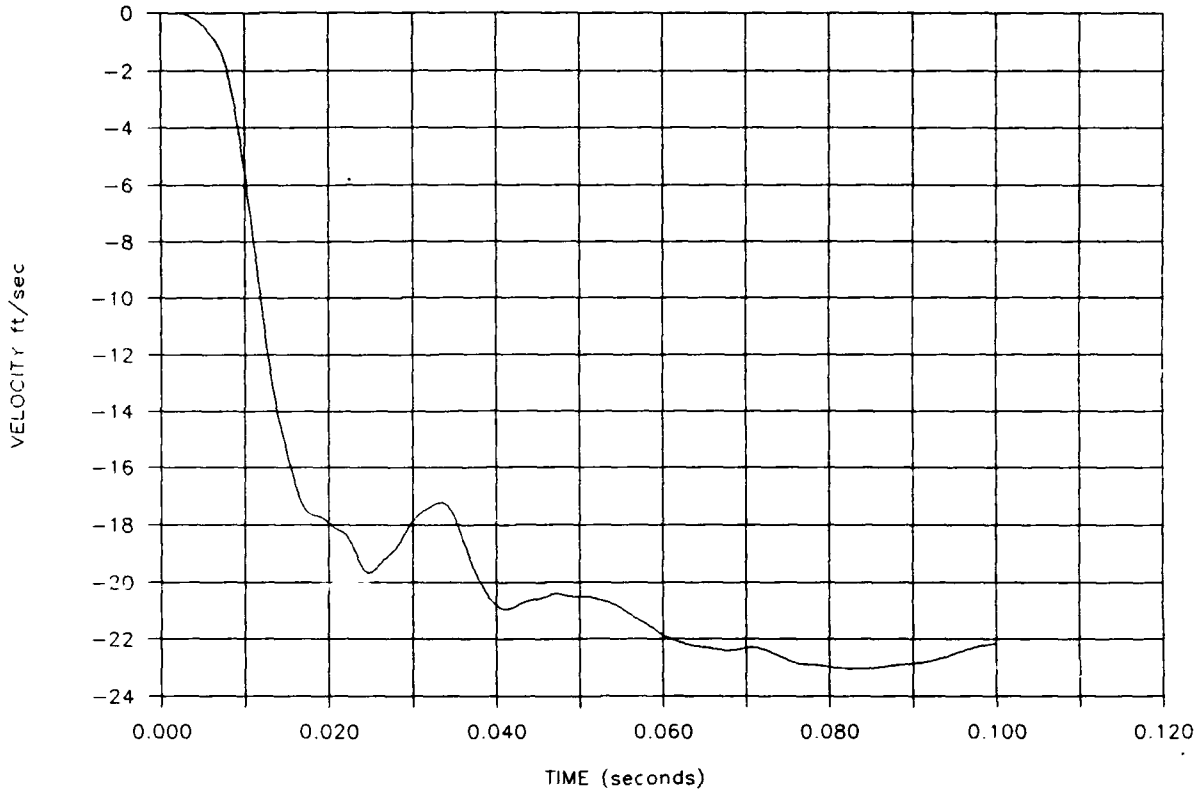
TEST 1, CH 7



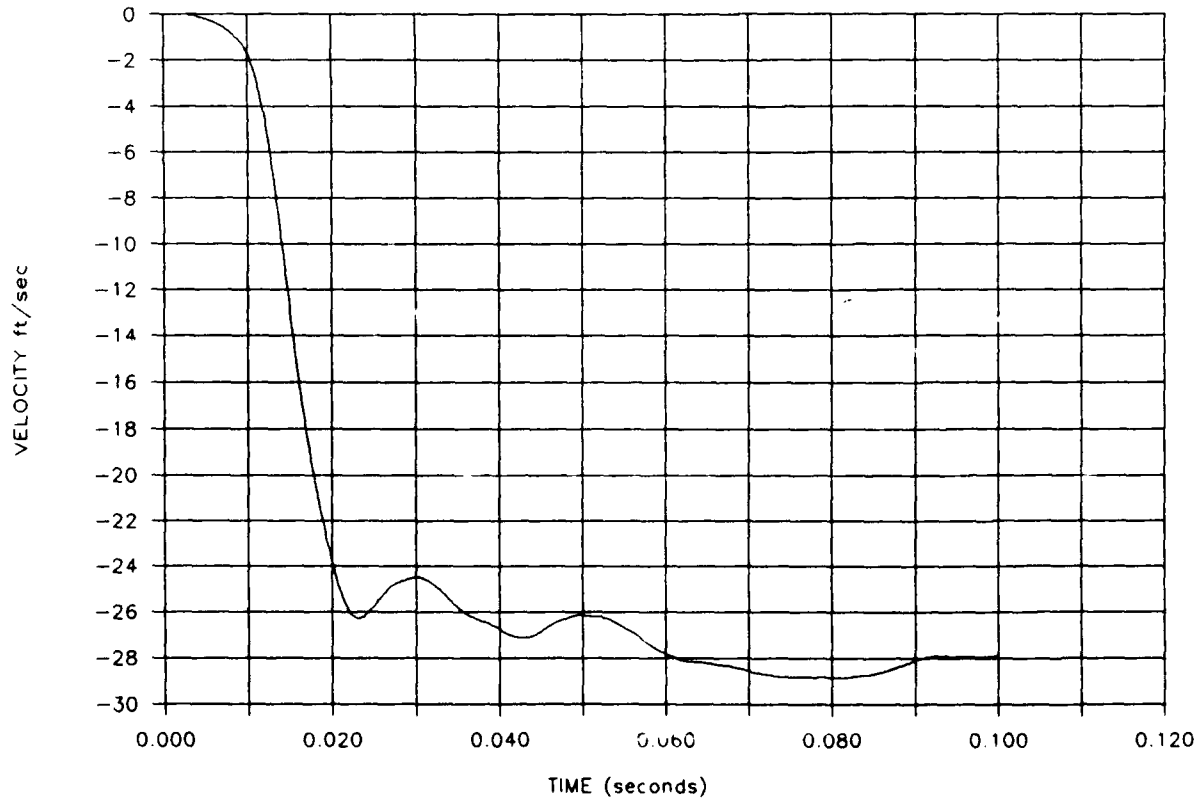
TEST 1, CH 8



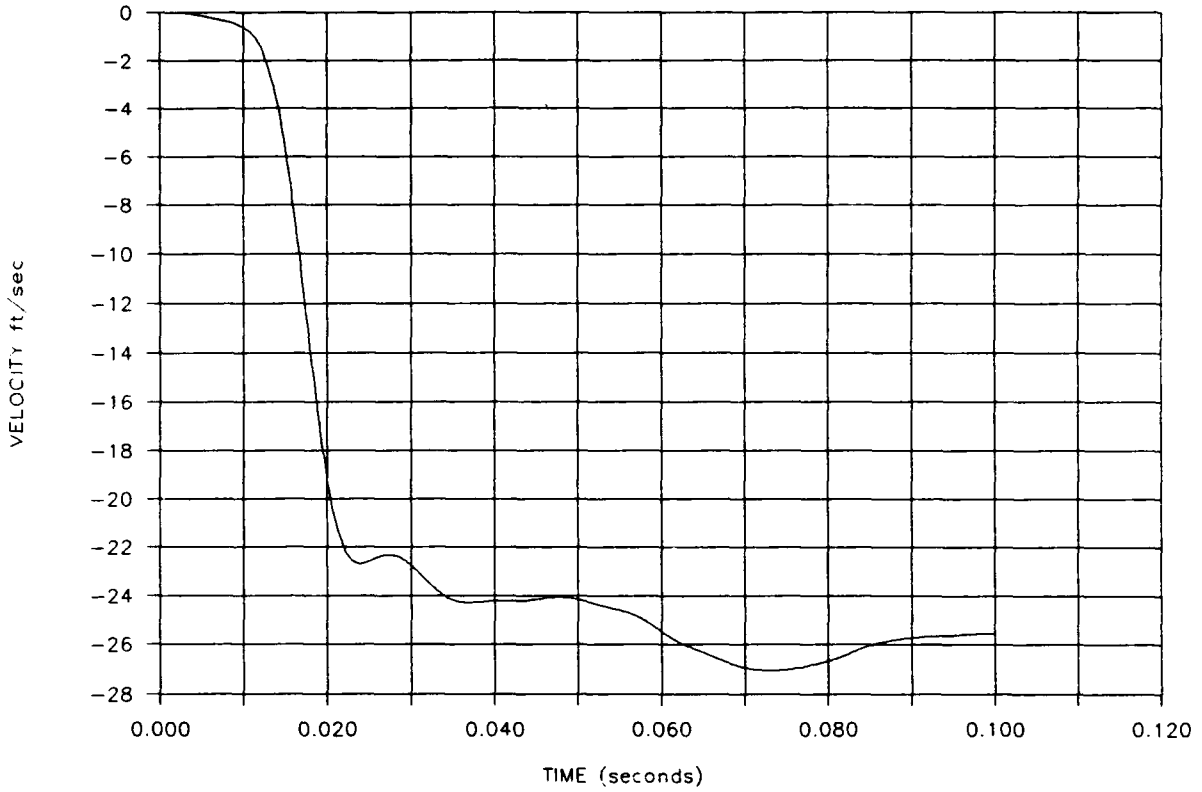
TEST 1, CH 9



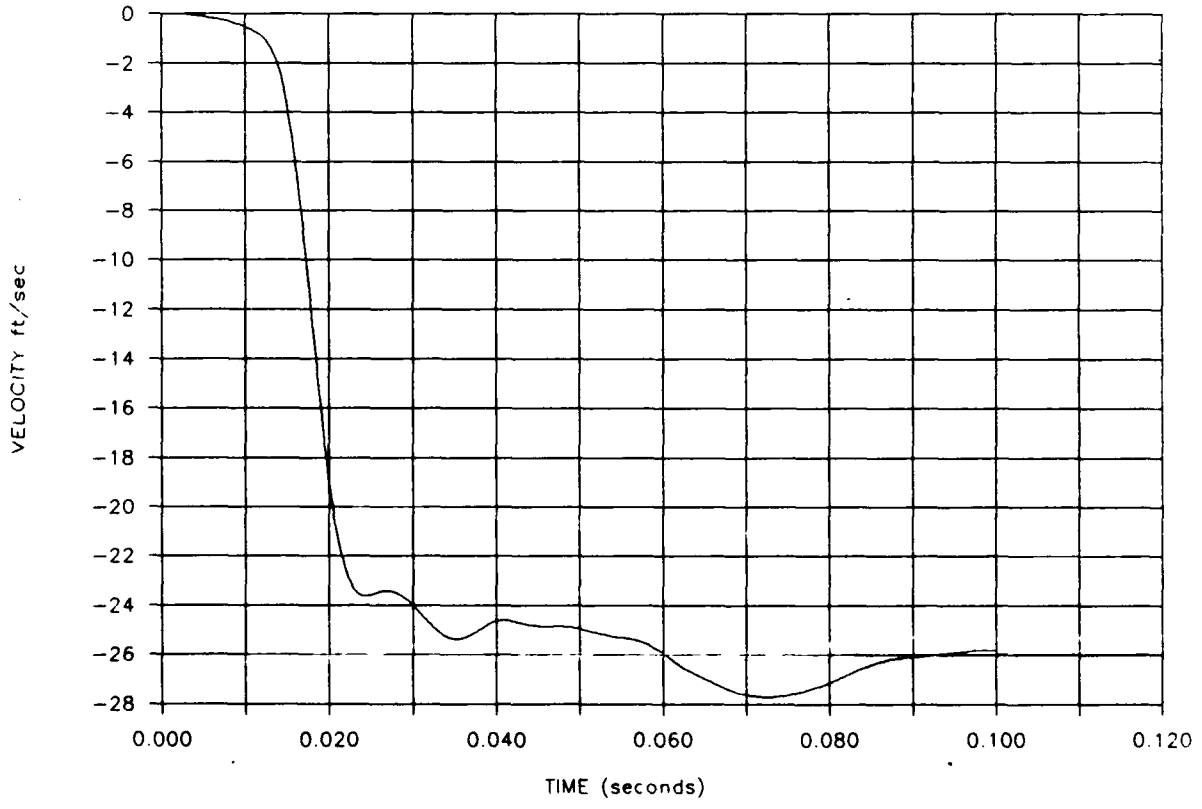
TEST 1, CH 10



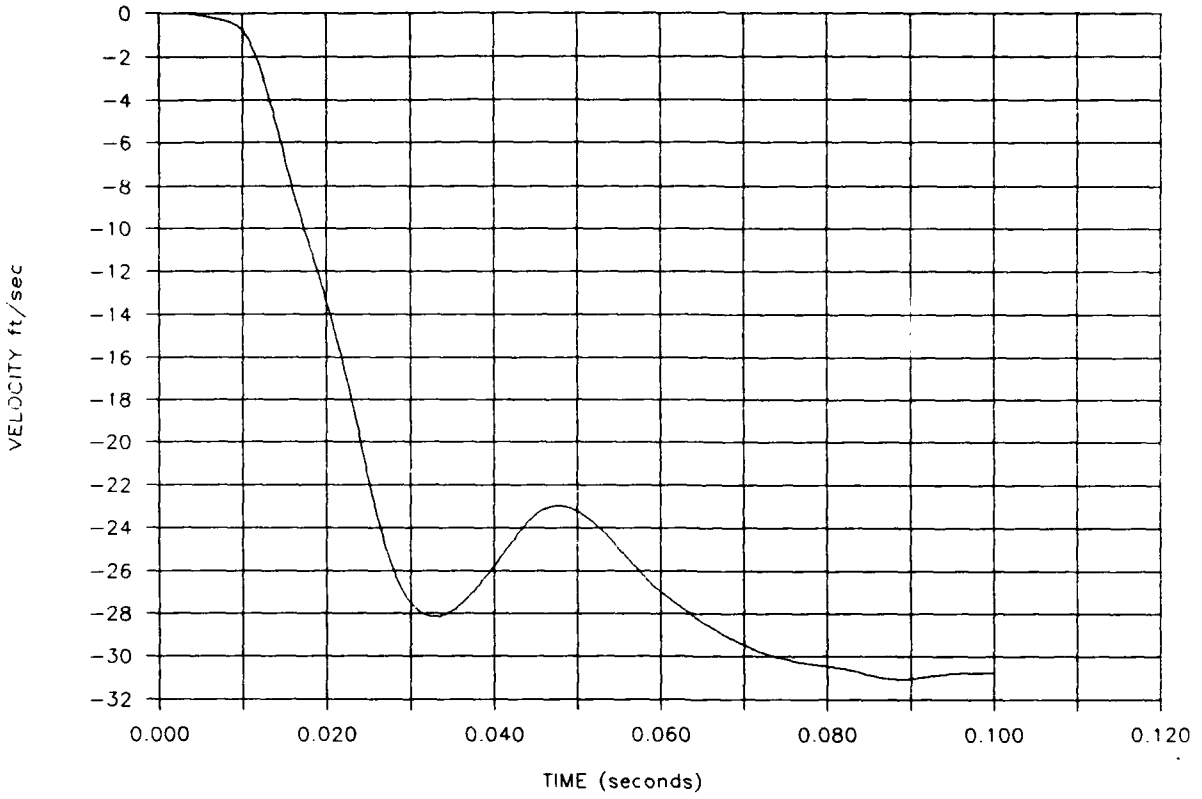
TEST 1, CH 11



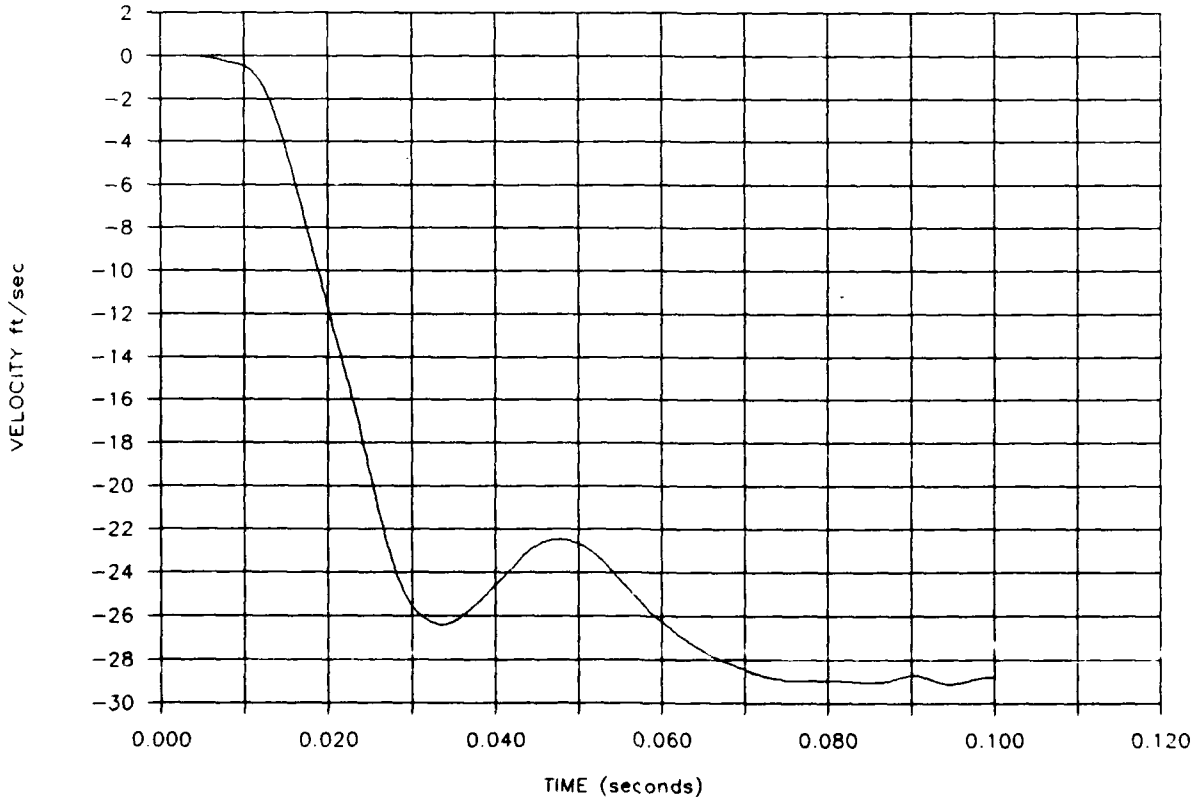
TEST 1, CH 12



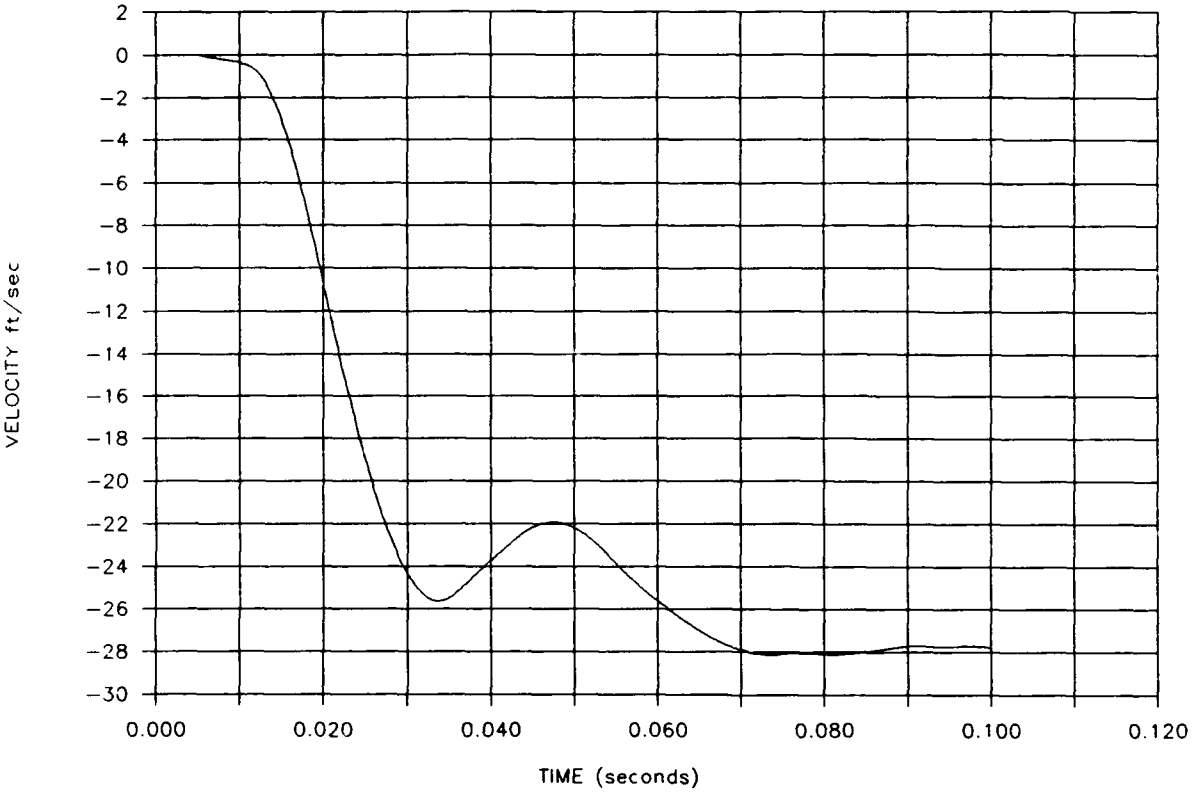
TEST 1, CH 18



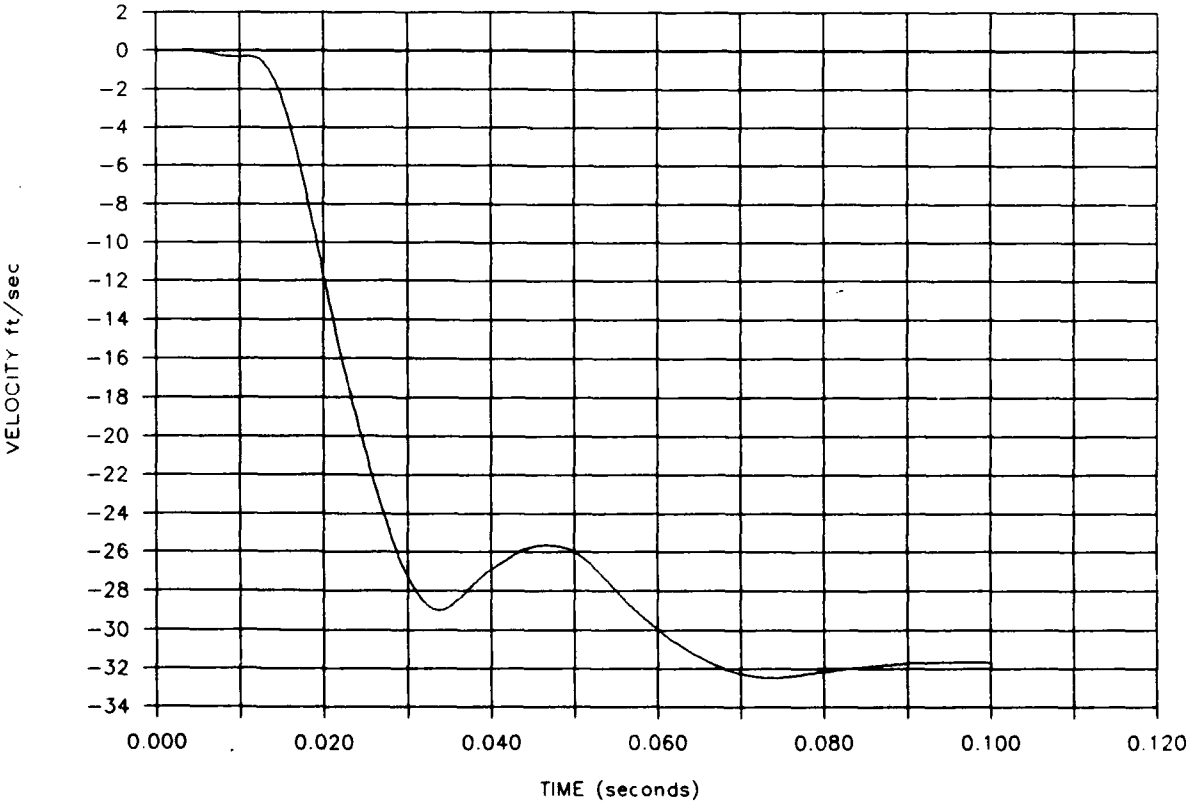
TEST 1, CH 19



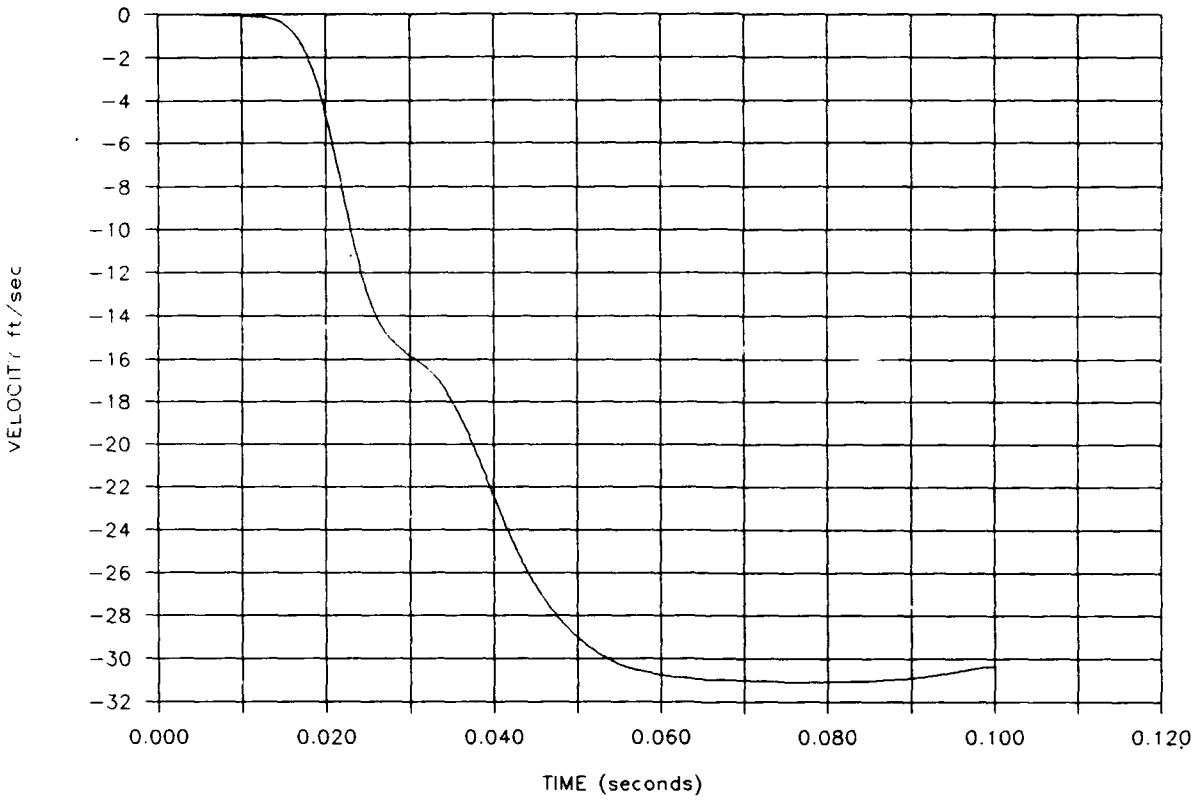
TEST 1, CH 20



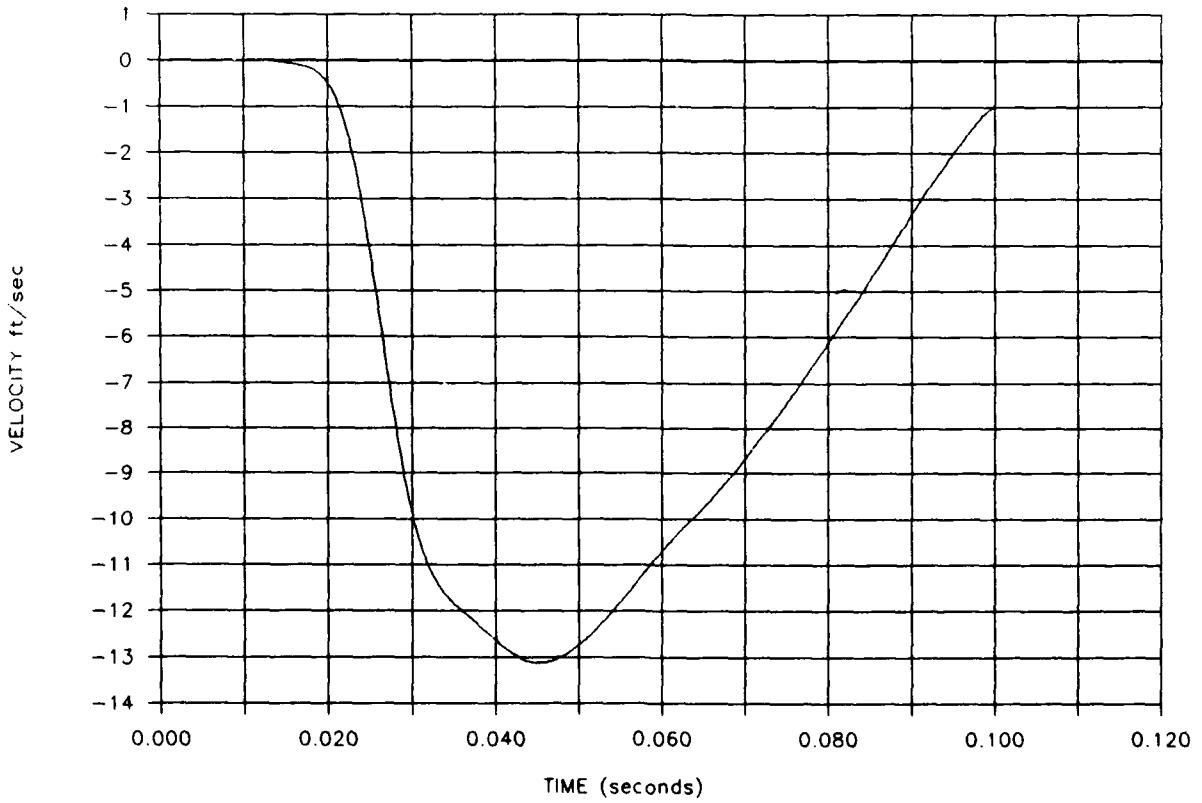
TEST 1, CH 22



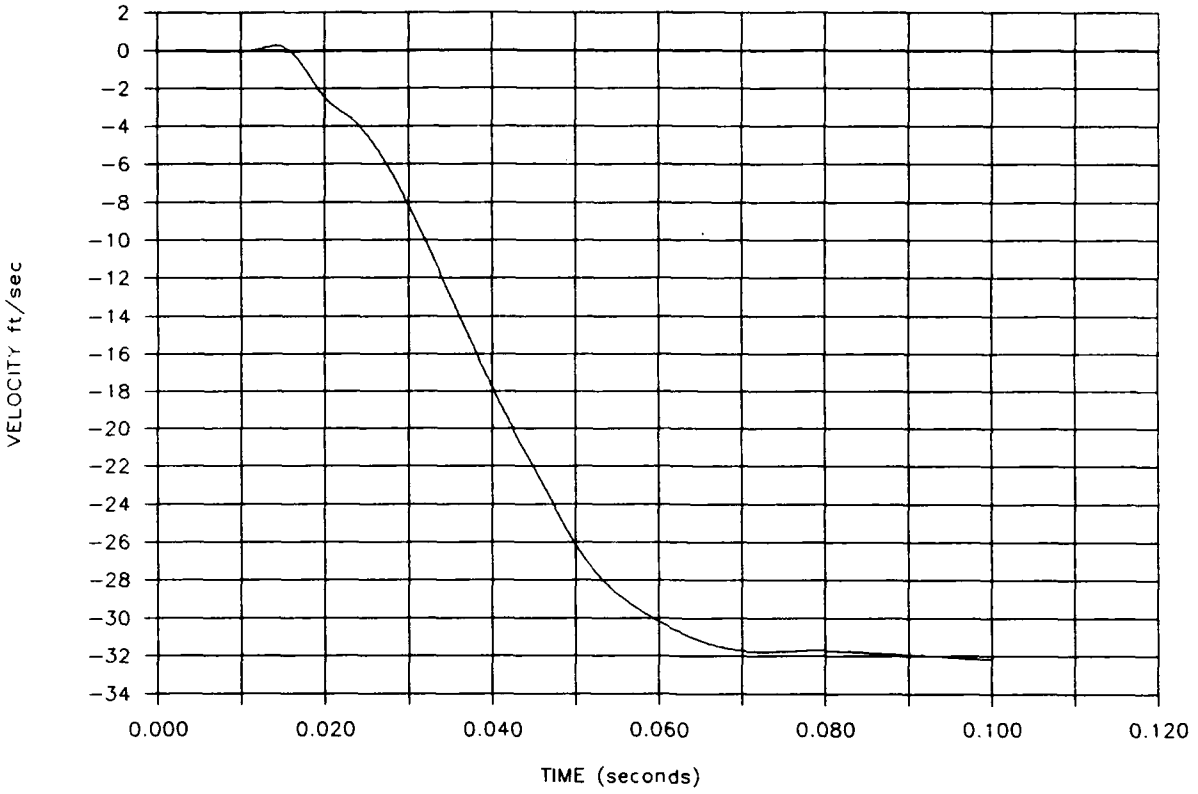
TEST 1, CH 25



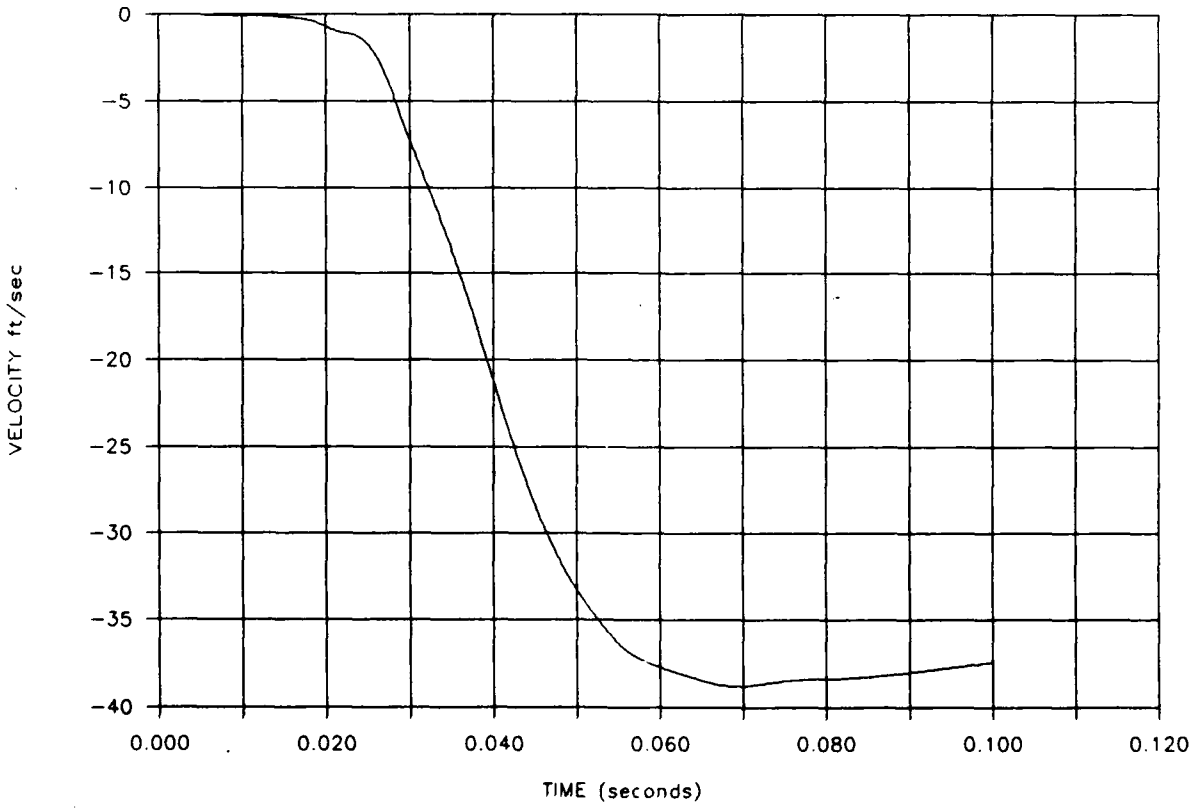
TEST 1, CH 26



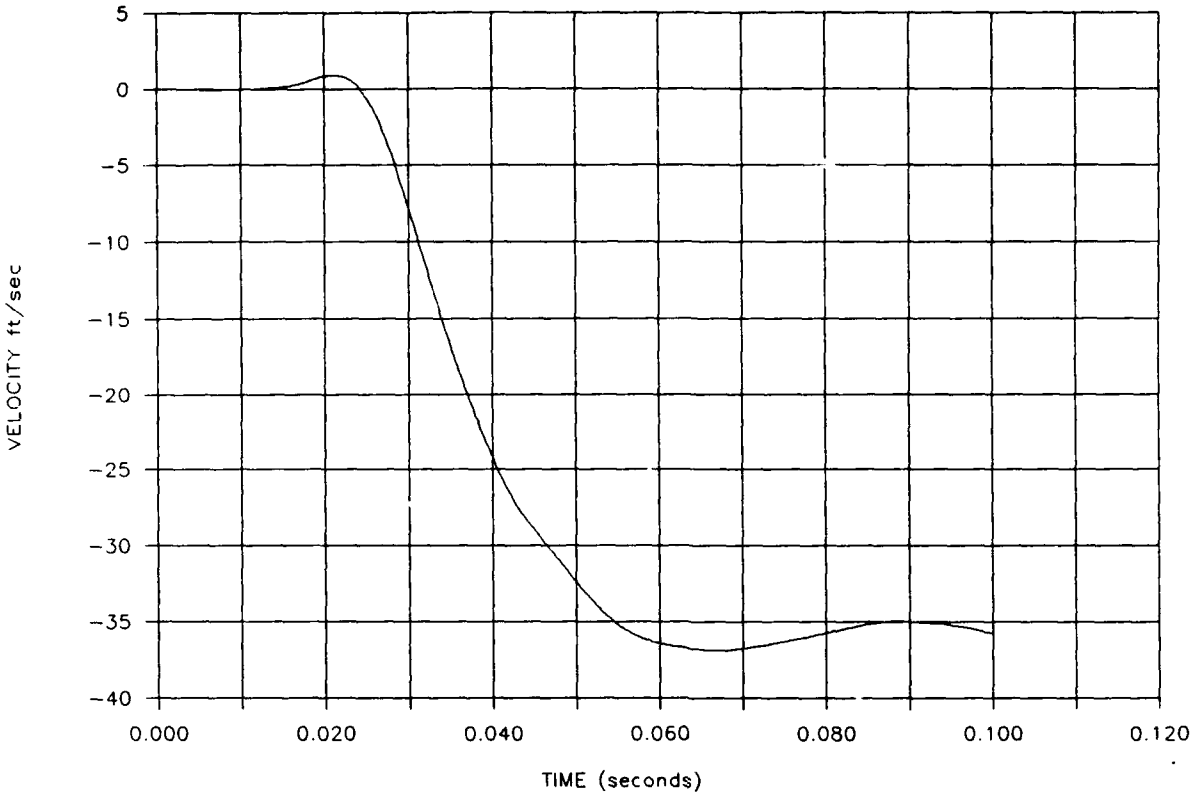
TEST 1, CH 27



TEST 1, CH 28

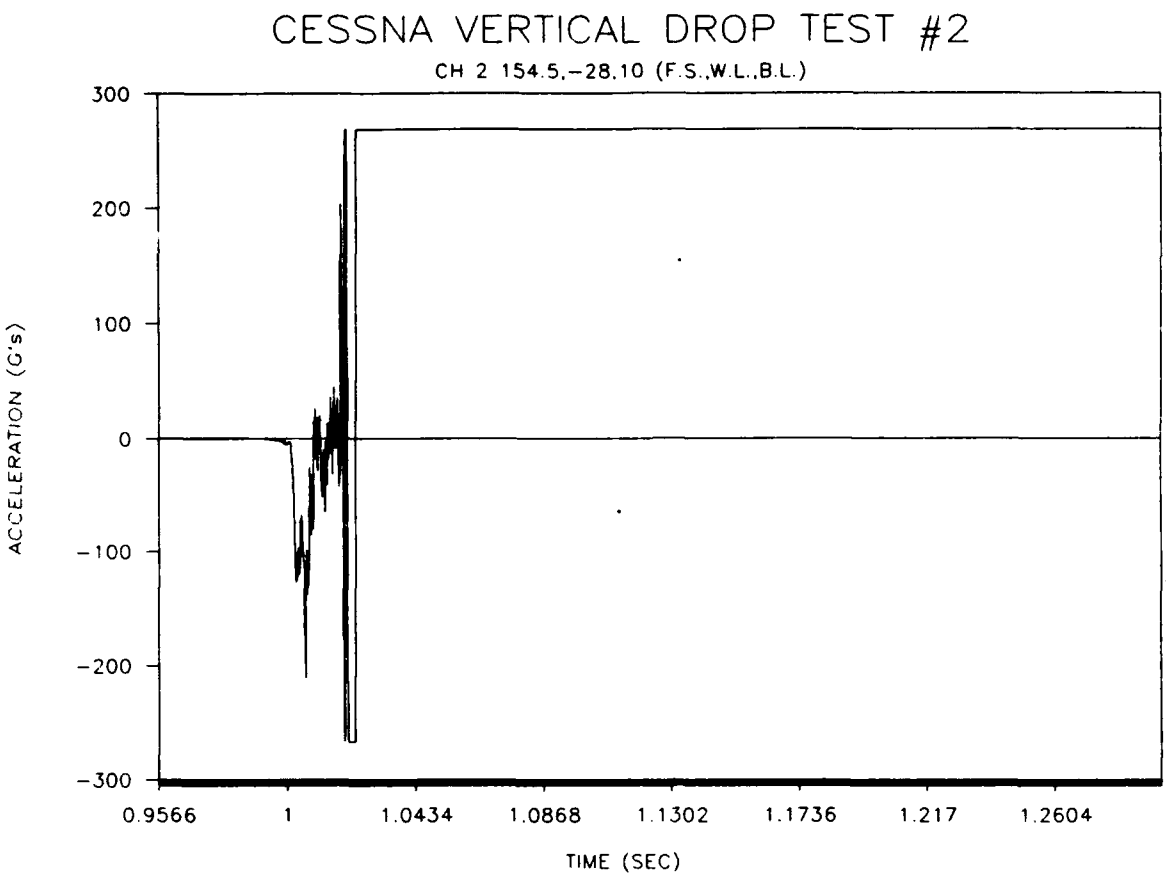


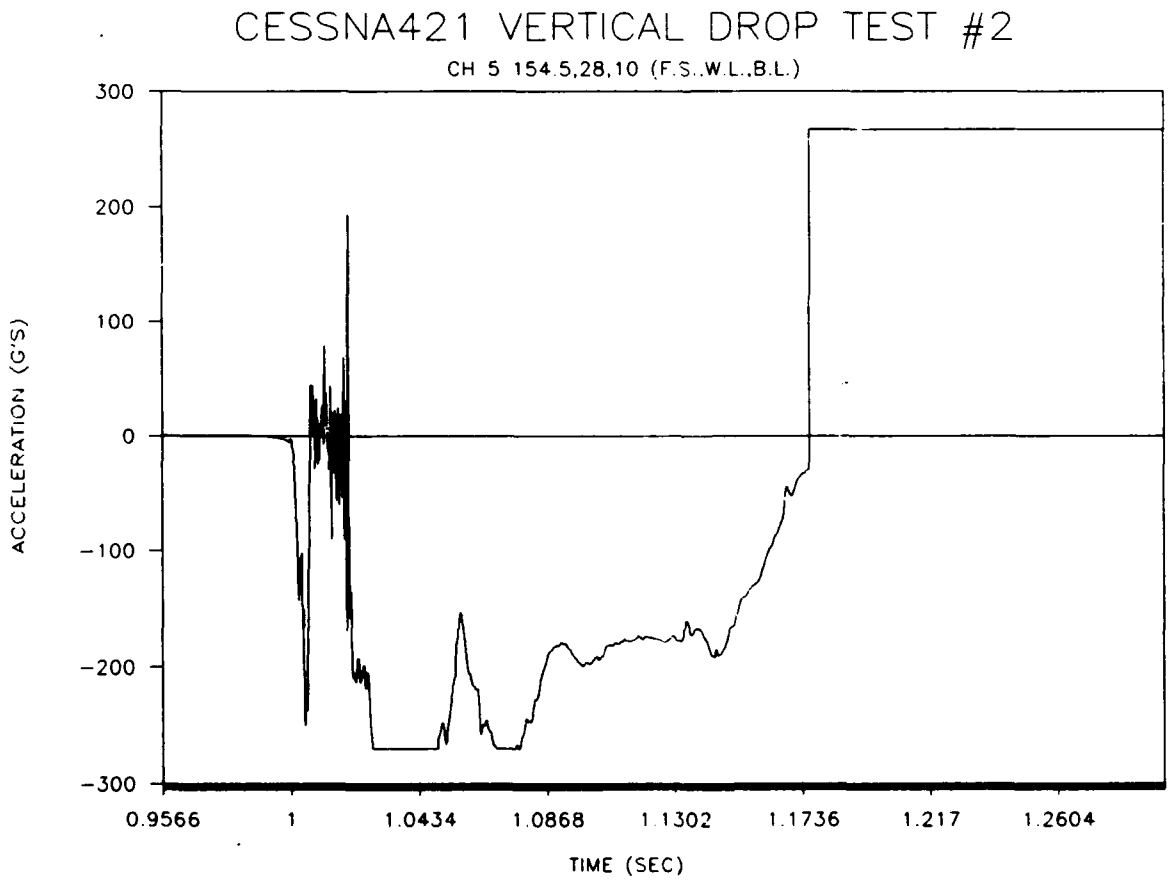
TEST 1, CH 29

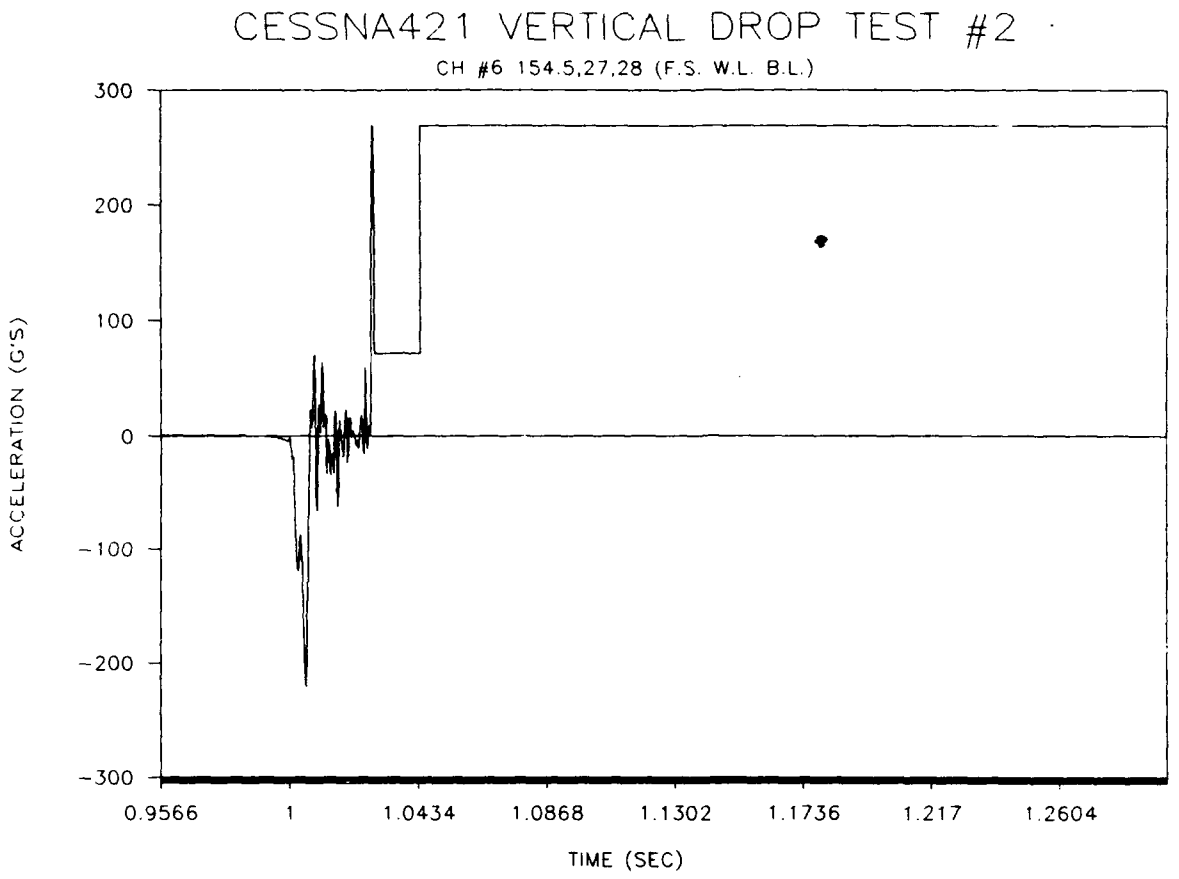

5
0
-5
-10
-15
-20
-25
-30
-35
-40
VELOCITY ft/sec
0.000
0.020
0.040
0.060
0.080
0.100
0.120
TIME (seconds)

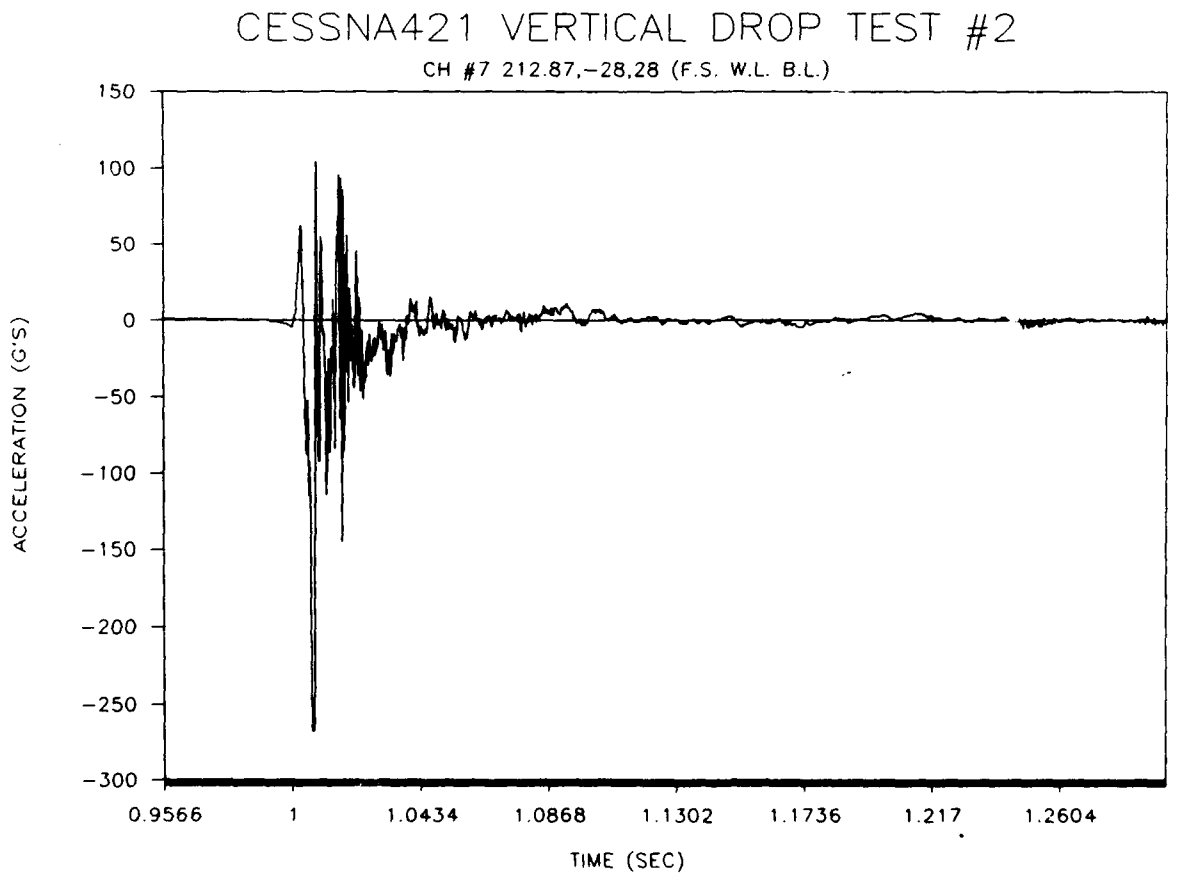
APPENDIX B

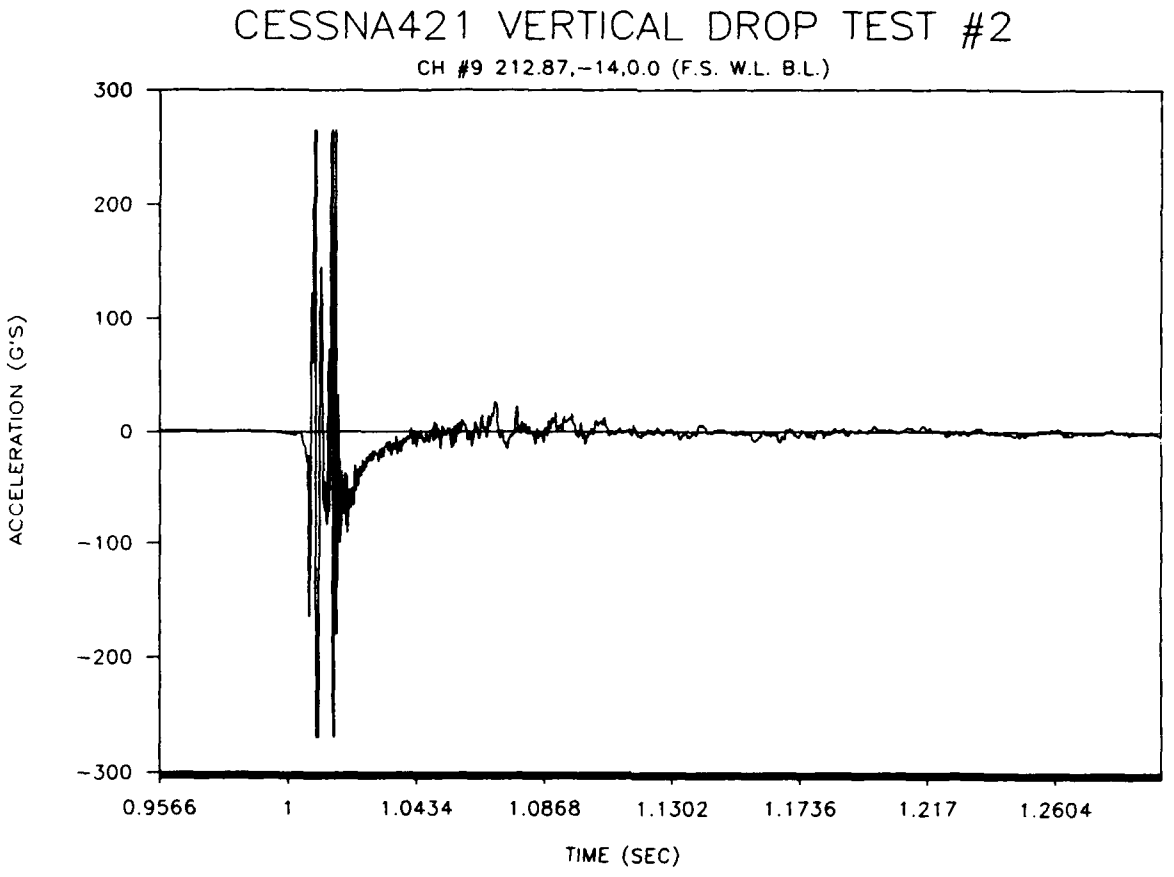
DATA PLOTS - TEST TWO

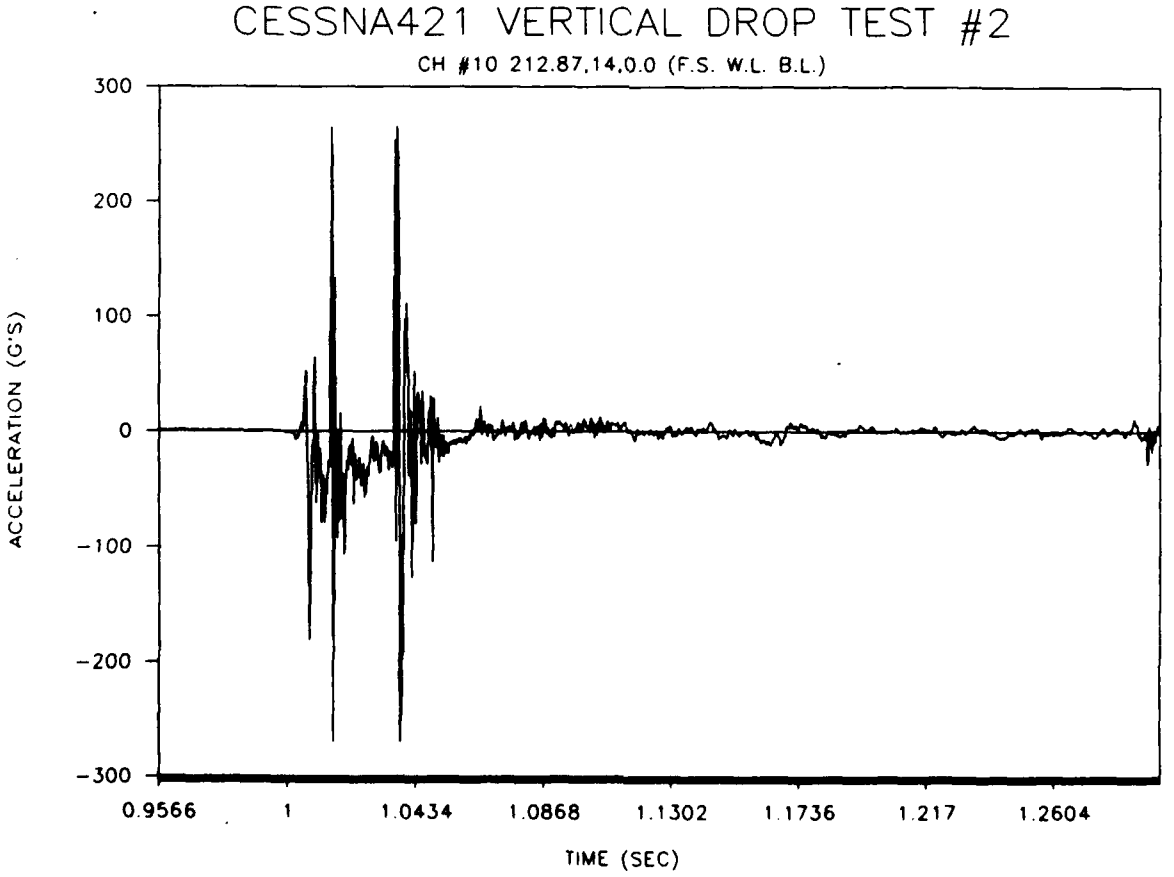

CESSNA VERTICAL DROP TEST #2
CH 2 154.5,-28,10 (F.S.,W.L.,B.L.)
ACCELERATION (G's)
300
200
100
0
-100
-200
-300
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

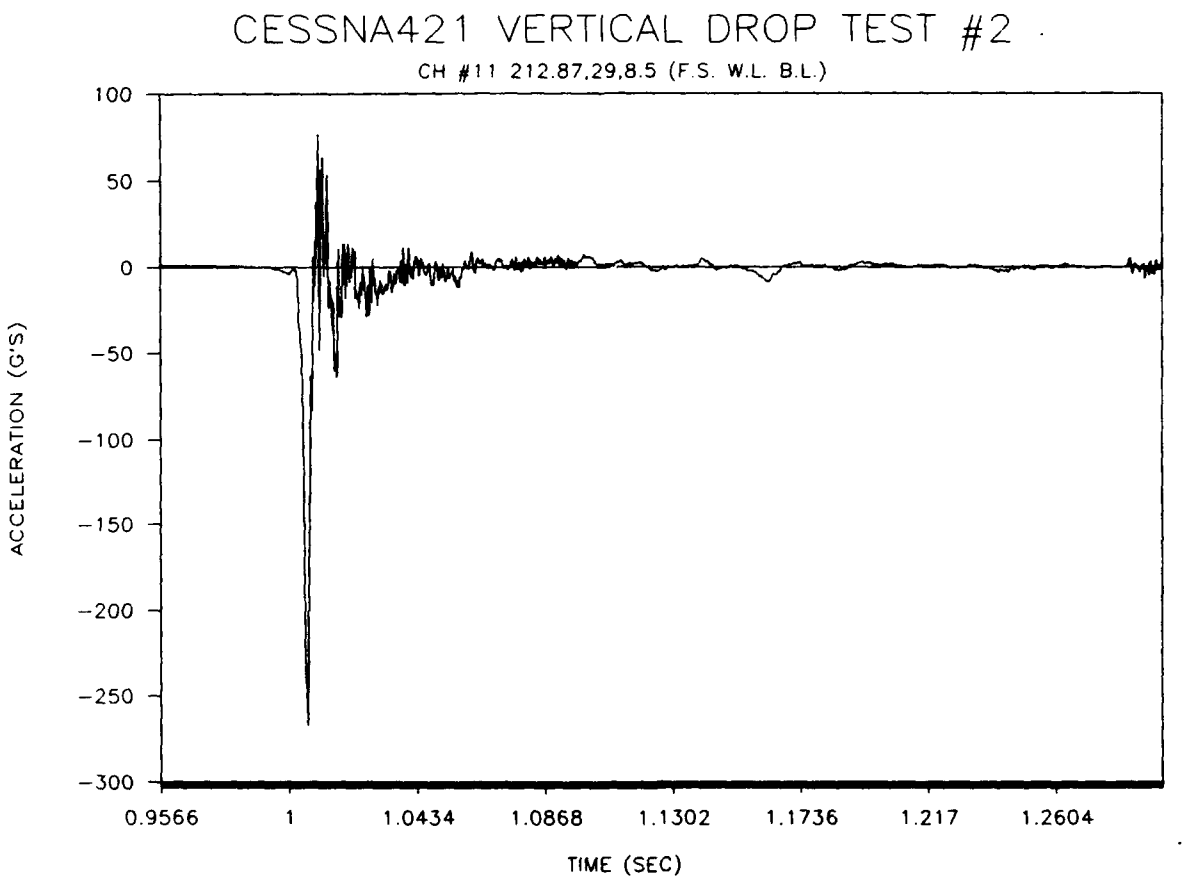

CESSNA421 VERTICAL DROP TEST #2
CH 5 154.5,28,10 (F.S.,W.L.,B.L.)
ACCELERATION (G'S)
300
200
100
0
-100
-200
-300
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

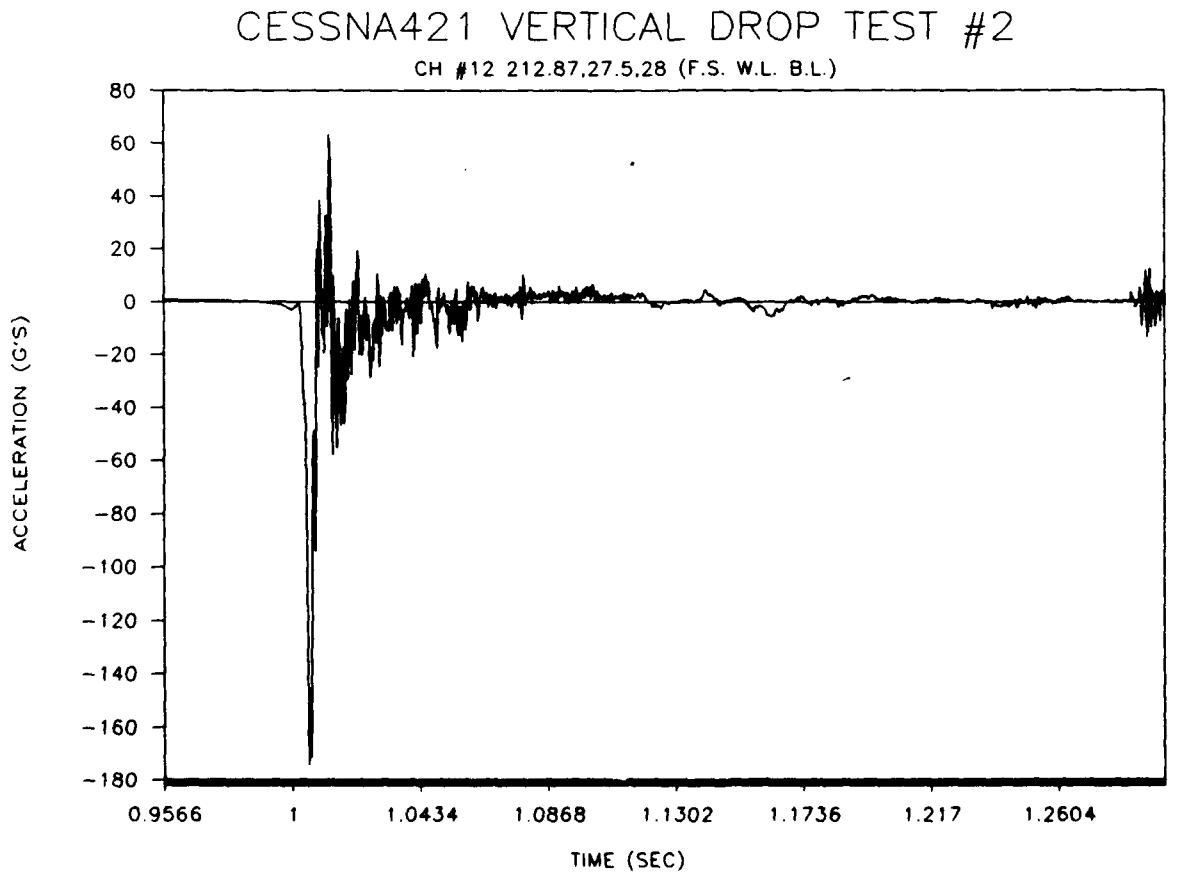

CESSNA421 VERTICAL DROP TEST #2
CH #6 154.5,27,28 (F.S. W.L. B.L.)
ACCELERATION (G'S)
300
200
100
0
-100
-200
-300
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

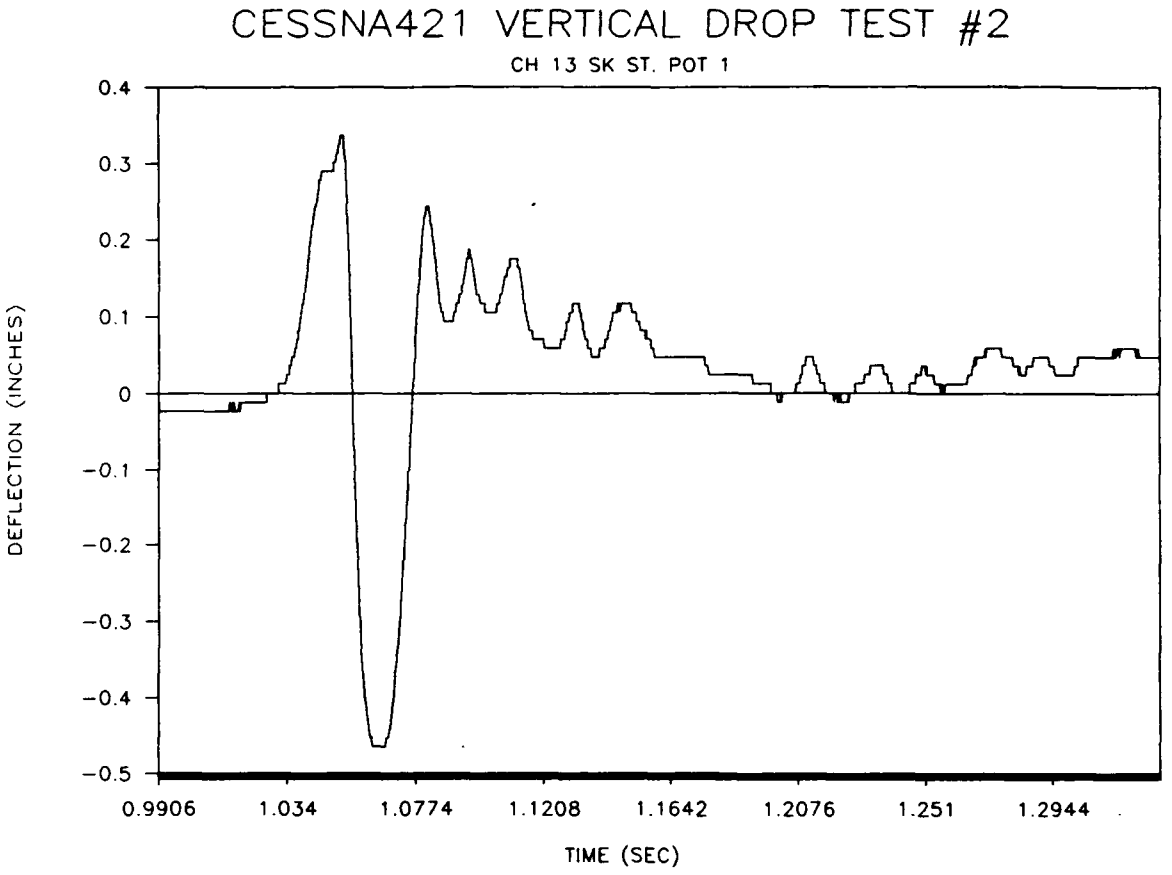

CESSNA421 VERTICAL DROP TEST #2
CH #7 212.87,-28,28 (F.S. W.L. B.L.)
ACCELERATION (G'S)
150
100
50
0
-50
-100
-150
-200
-250
-300
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

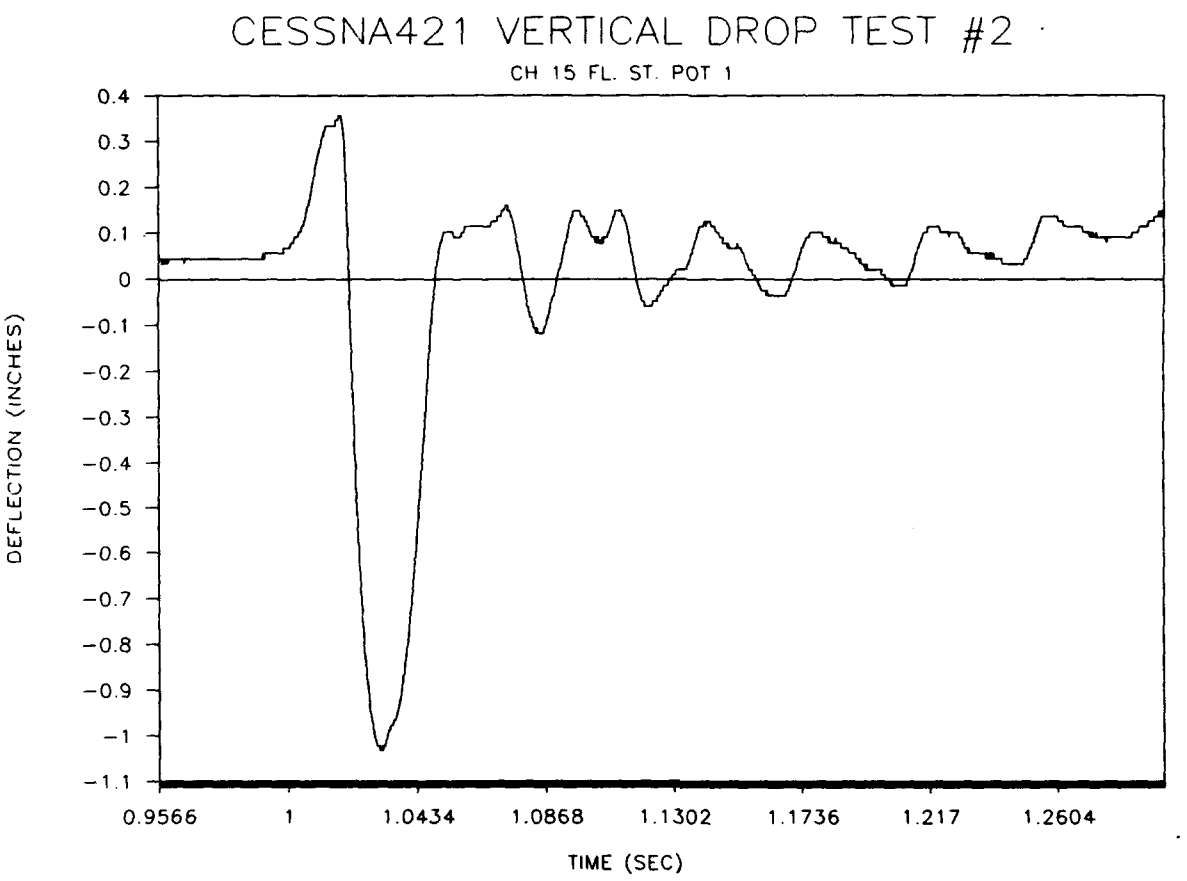

CESSNA421 VERTICAL DROP TEST #2
CH #9 212.87,-14,0.0 (F.S. W.L. B.L.)
ACCELERATION (G'S)
300
200
100
0
-100
-200
-300
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

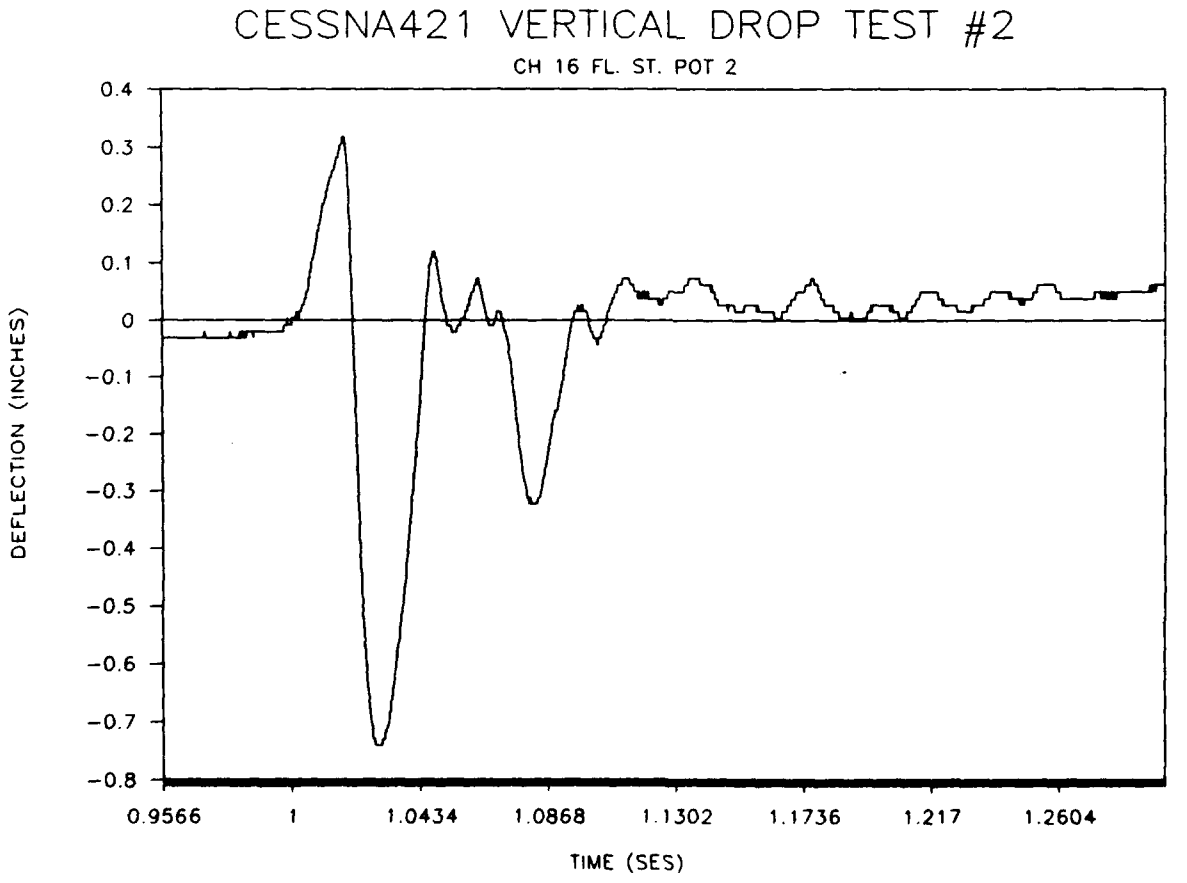

CESSNA421 VERTICAL DROP TEST #2
CH #10 212.87,14,0.0 (F.S. W.L. B.L.)
ACCELERATION (G'S)
300
200
100
0
-100
-200
-300
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

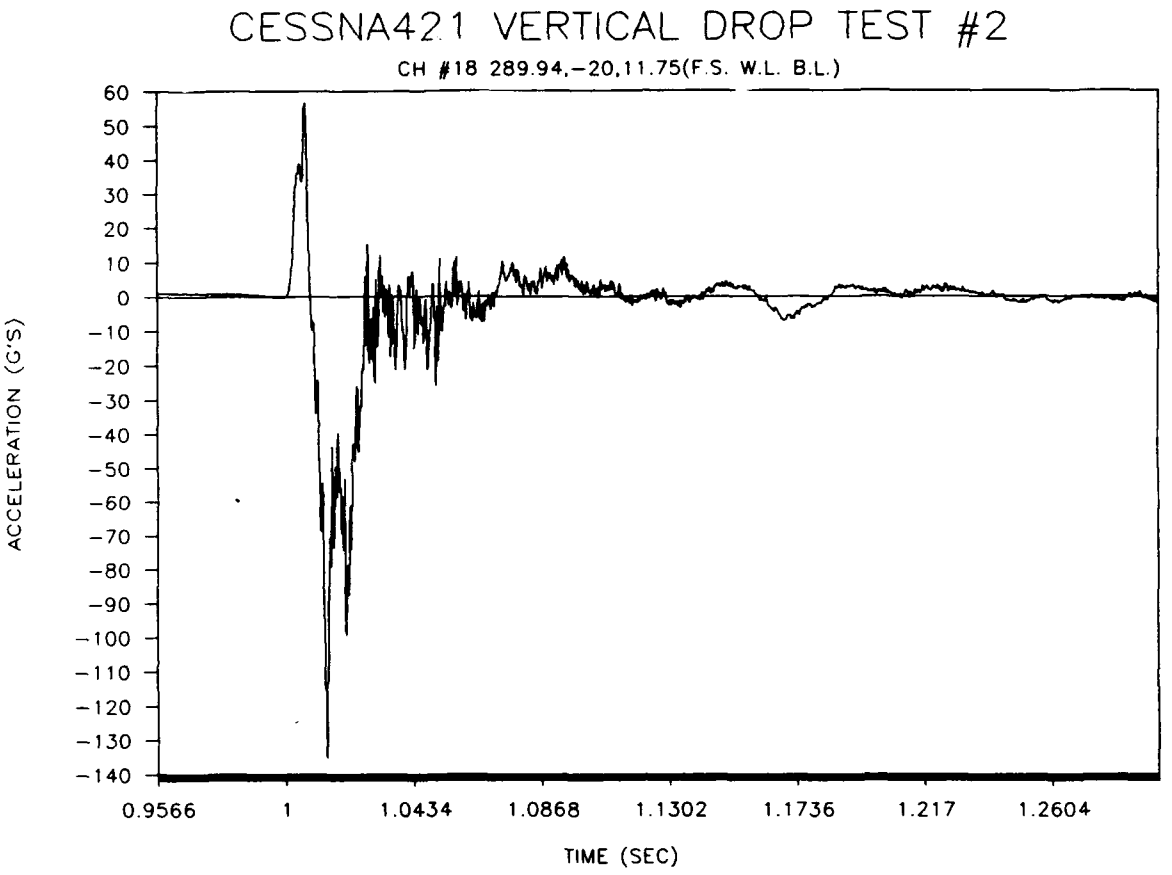

CESSNA421 VERTICAL DROP TEST #2
CH #11 212.87,29,8.5 (F.S. W.L. B.L.)
ACCELERATION (G'S)
100
50
0
-50
-100
-150
-200
-250
-300
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

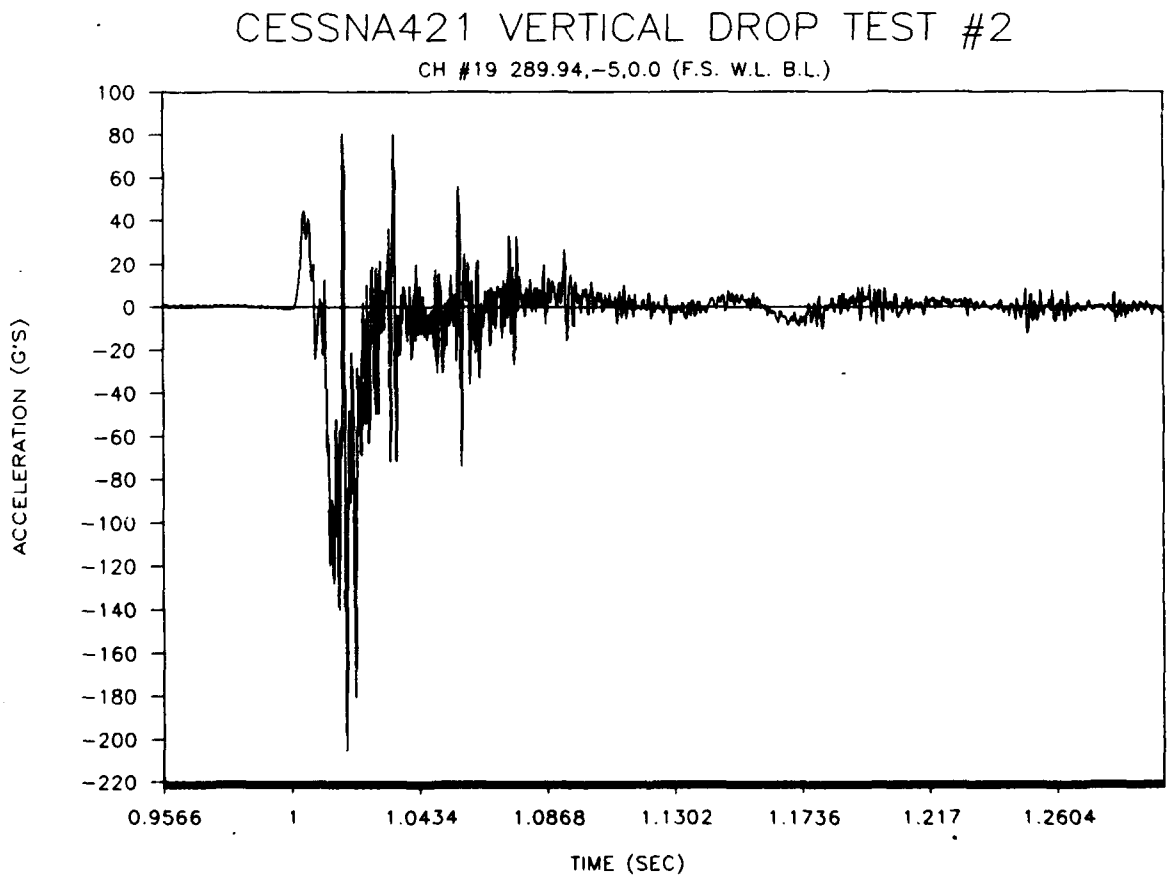

CESSNA421 VERTICAL DROP TEST #2
CH #12 212.87,27.5,28 (F.S. W.L. B.L.)
ACCELERATION (G'S)
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

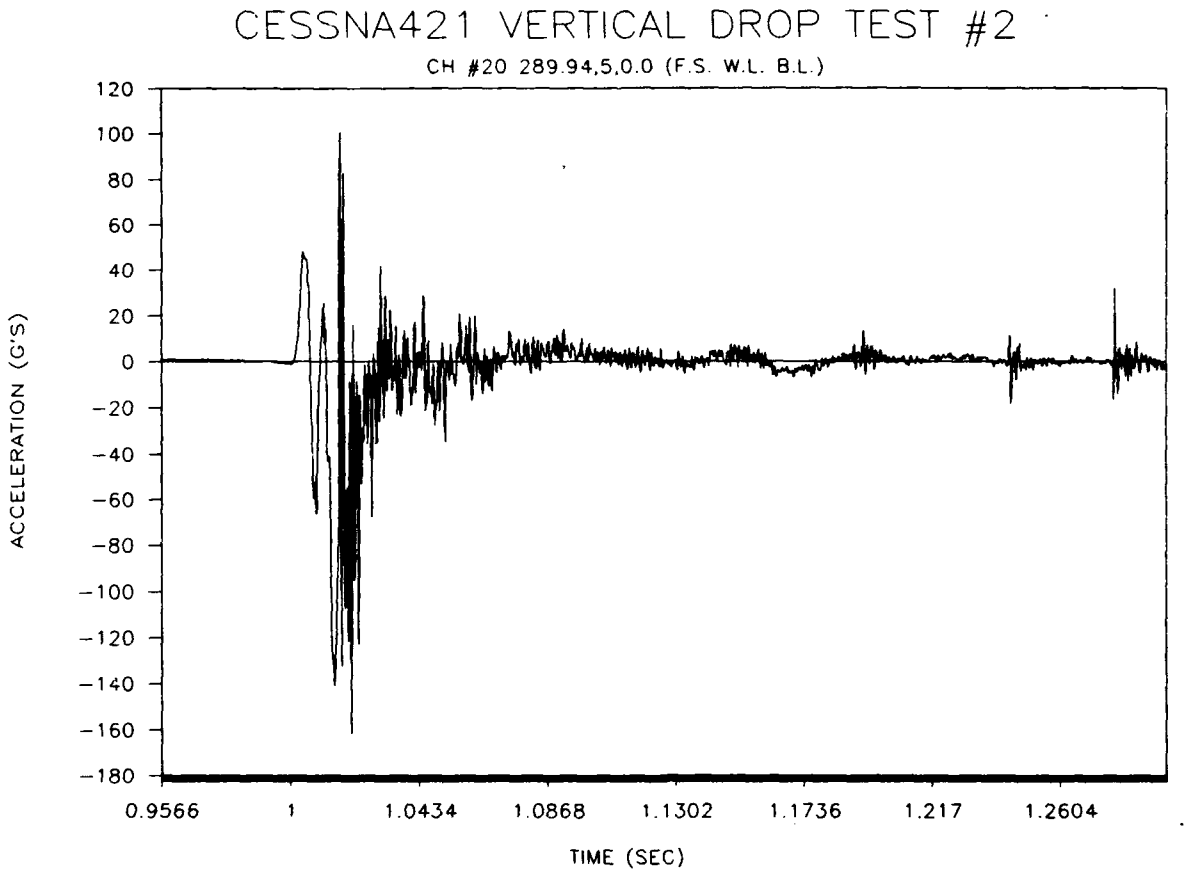

CESSNA421 VERTICAL DROP TEST #2
CH 13 SK ST. POT 1
DEFLECTION (INCHES)
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0.9906
1.034
1.0774
1.1208
1.1642
1.2076
1.251
1.2944
TIME (SEC)

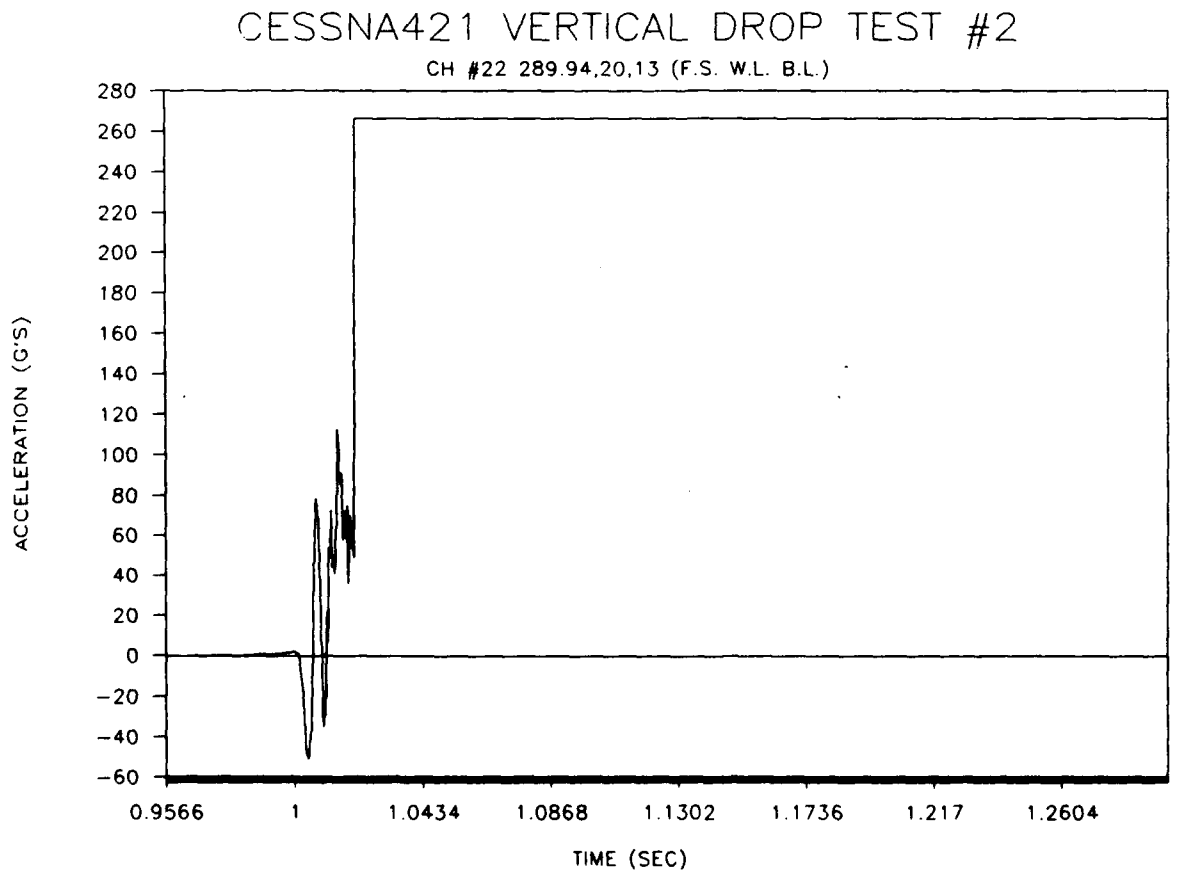

CESSNA421 VERTICAL DROP TEST #2
CH 15 FL. ST. POT 1
DEFLECTION (INCHES)
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

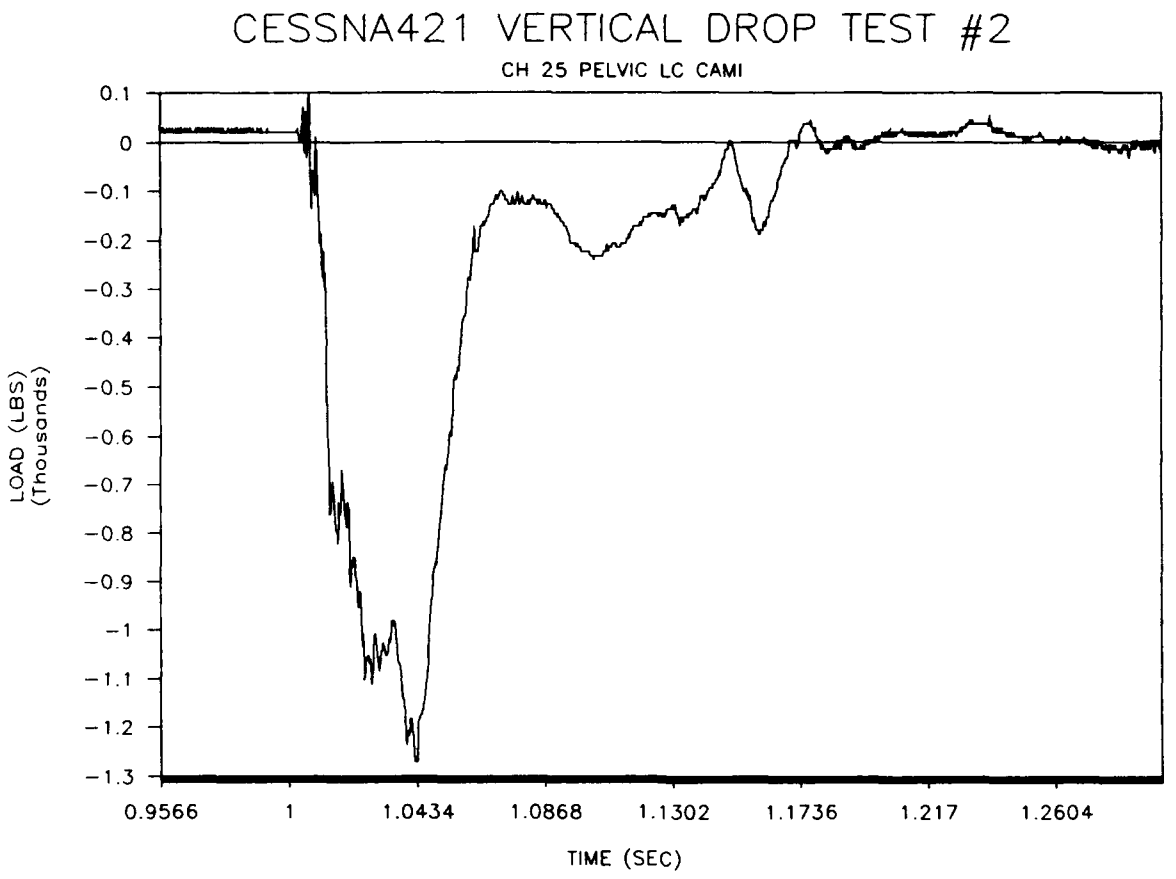

CESSNA421 VERTICAL DROP TEST #2
CH 16 FL. ST. POT 2
DEFLECTION (INCHES)
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SES)

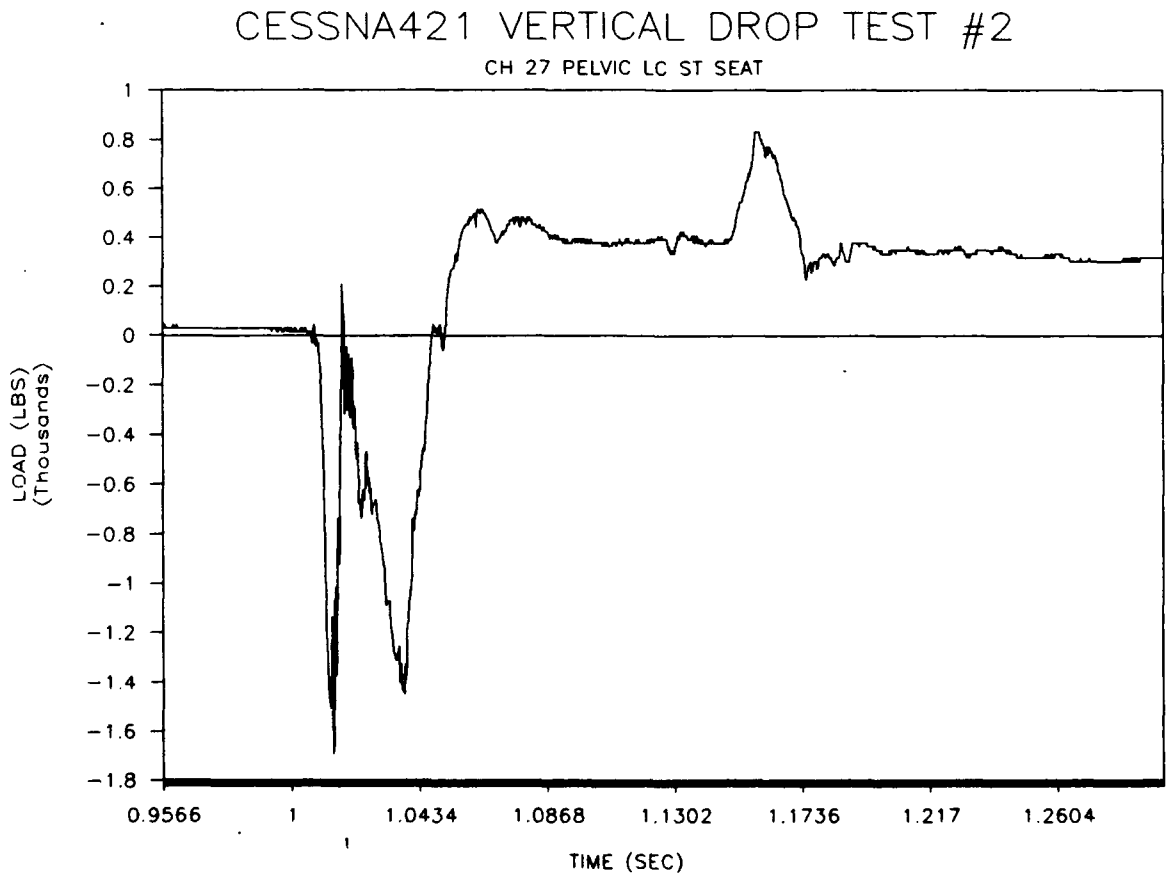

CESSNA421 VERTICAL DROP TEST #2
CH #18 289.94,-20,11.75(F.S. W.L. B.L.)
ACCELERATION (G'S)
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

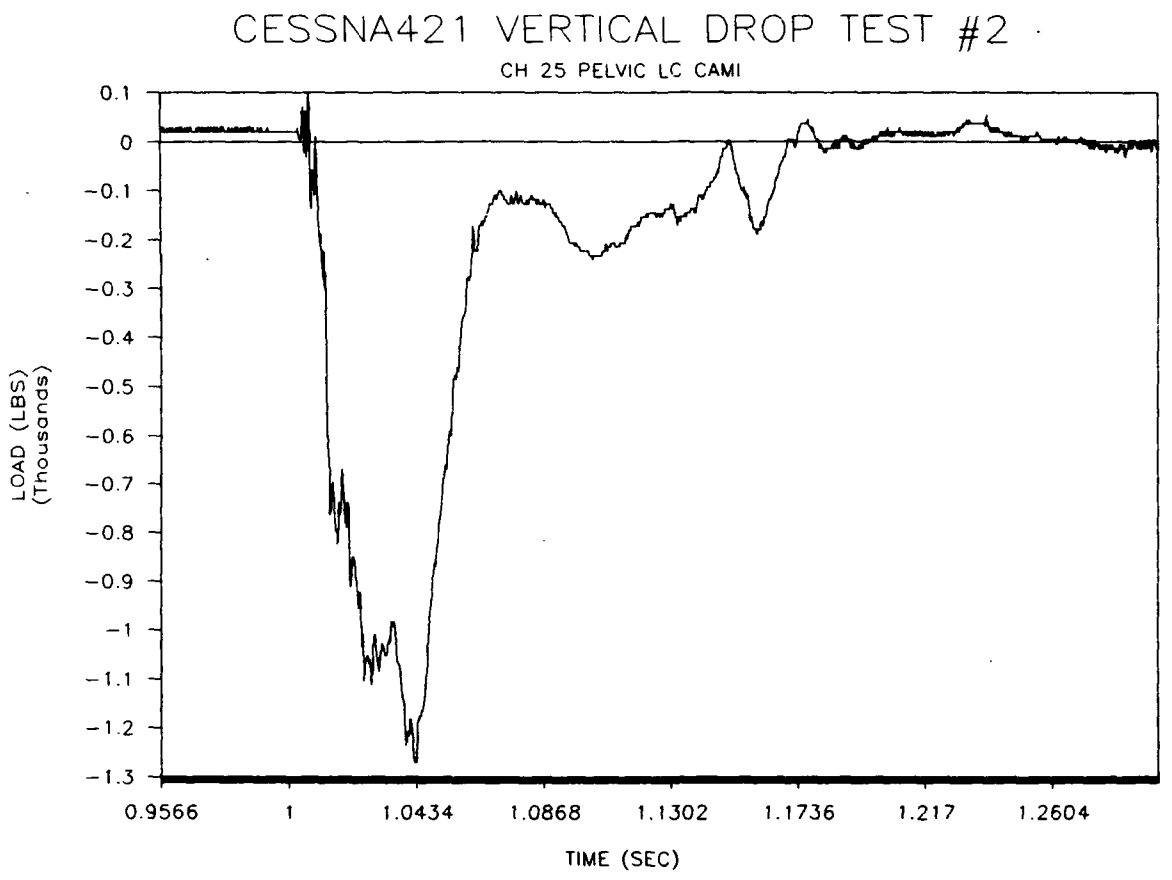

CESSNA421 VERTICAL DROP TEST #2
CH #19 289.94,-5,0.0 (F.S. W.L. B.L.)
ACCELERATION (G'S)
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

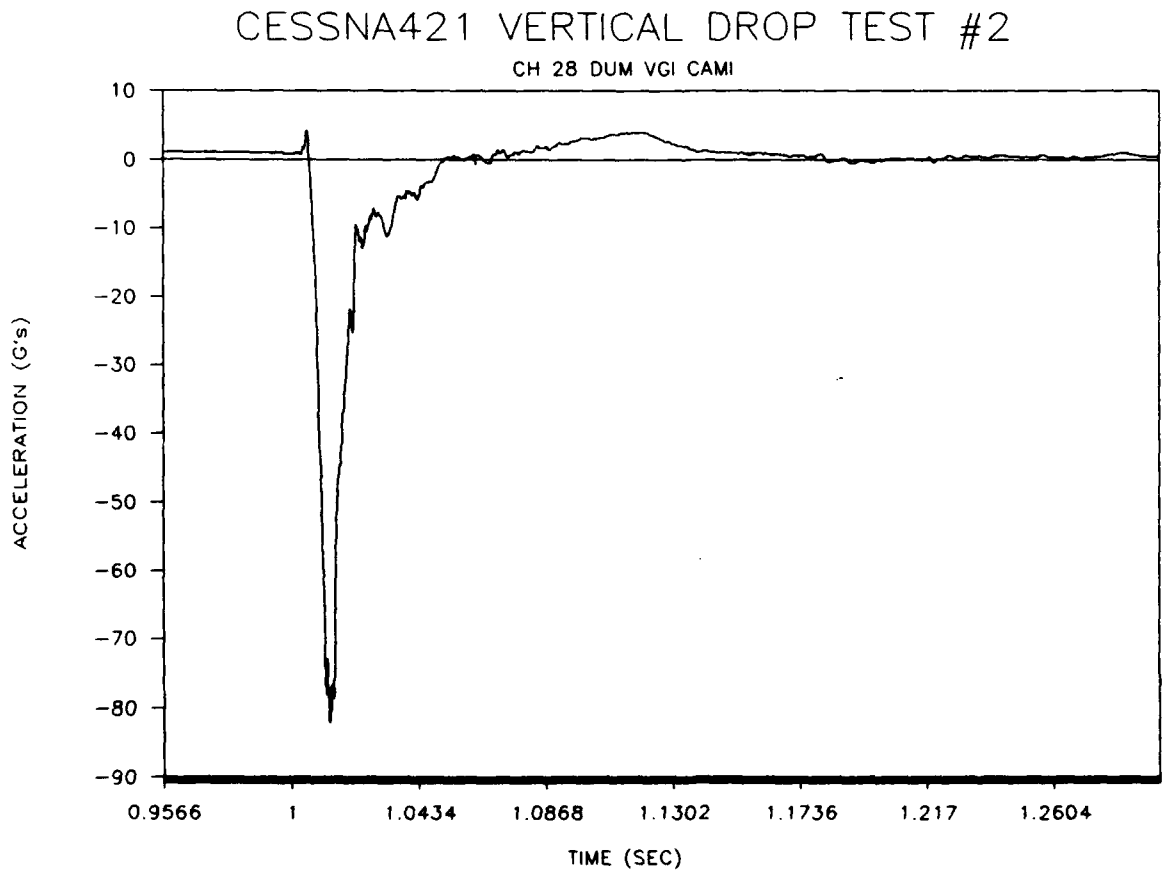

CESSNA421 VERTICAL DROP TEST #2
CH #20 289.94,5,0.0 (F.S. W.L. B.L.)
ACCELERATION (G'S)
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

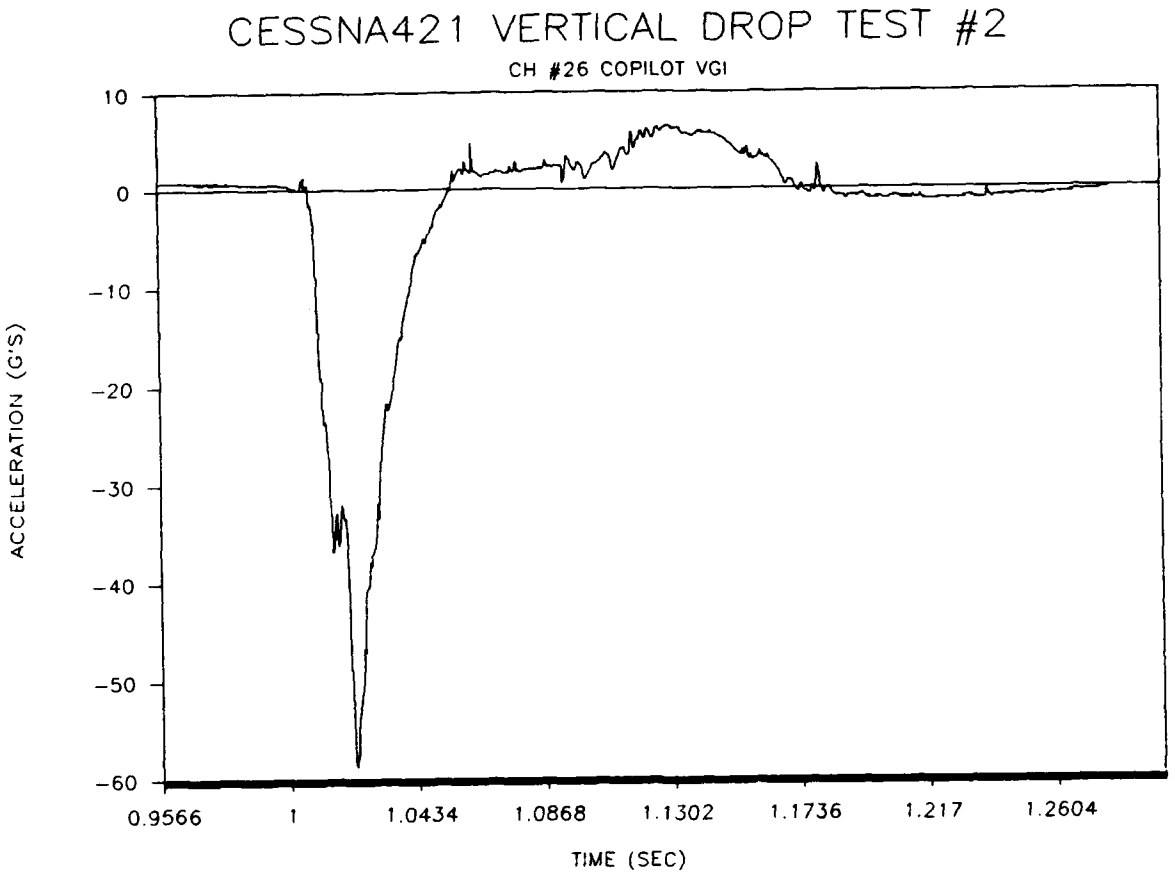

CESSNA421 VERTICAL DROP TEST #2
CH #22 289.94,20,13 (F.S. W.L. B.L.)
ACCELERATION (G'S)
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

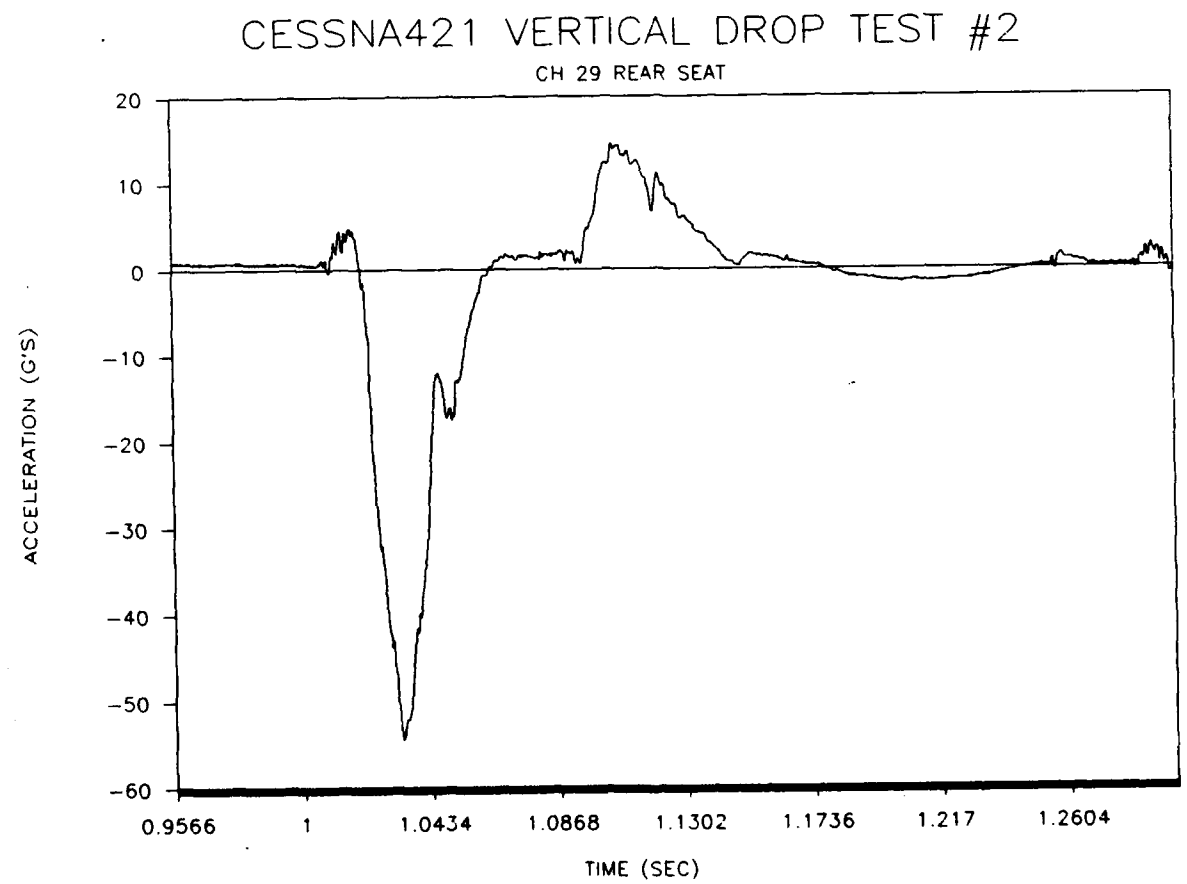

CESSNA421 VERTICAL DROP TEST #2
CH 25 PELVIC LC CAMI
LOAD (LBS)
(Thousands)
0.1
0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
−0.7
−0.8
−0.9
−1
−1.1
−1.2
−1.3
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

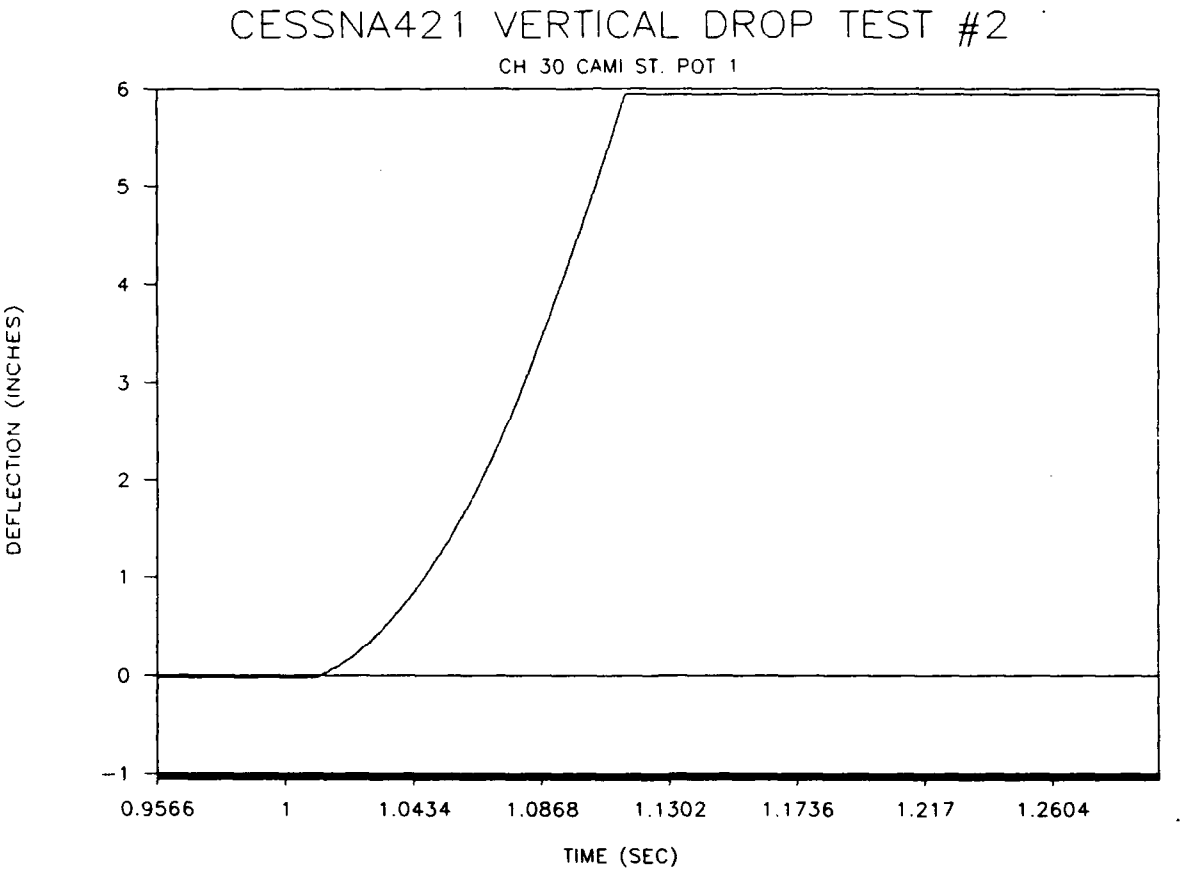

CESSNA421 VERTICAL DROP TEST #2
CH 27 PELVIC LC ST SEAT
LOAD (LBS)
(Thousands)
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
−1.2
−1.4
−1.6
−1.8
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

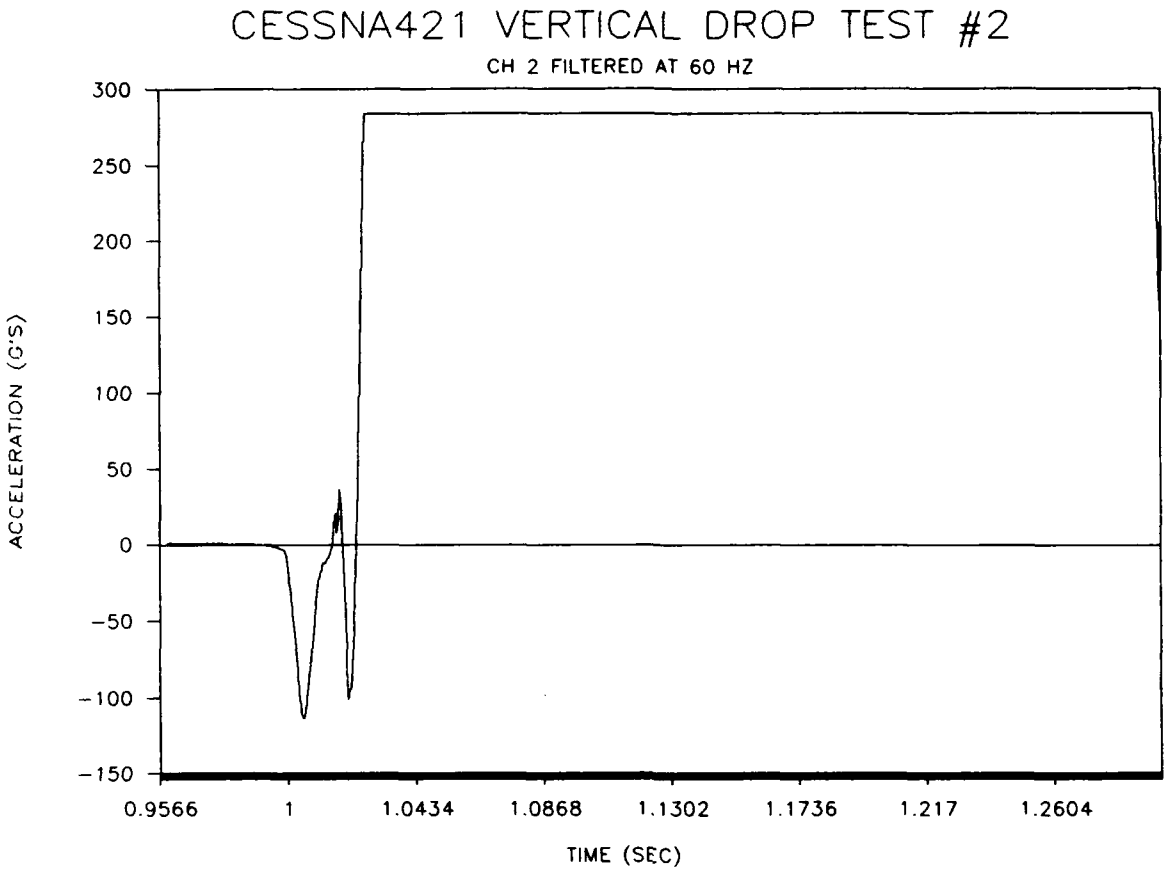

CESSNA421 VERTICAL DROP TEST #2
CH 25 PELVIC LC CAMI
LOAD (LBS)
(Thousands)
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

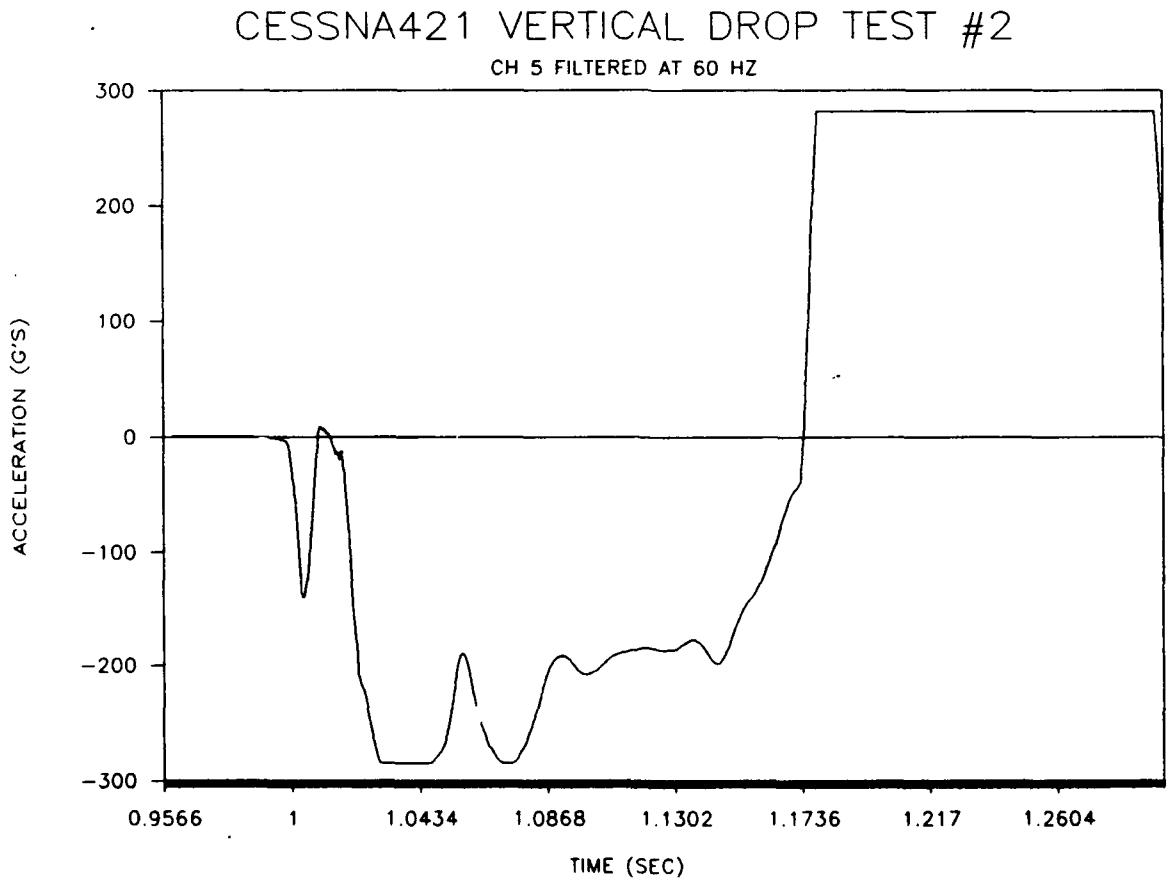

CESSNA421 VERTICAL DROP TEST #2
CH 28 DUM VGI CAMI
ACCELERATION (G's)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

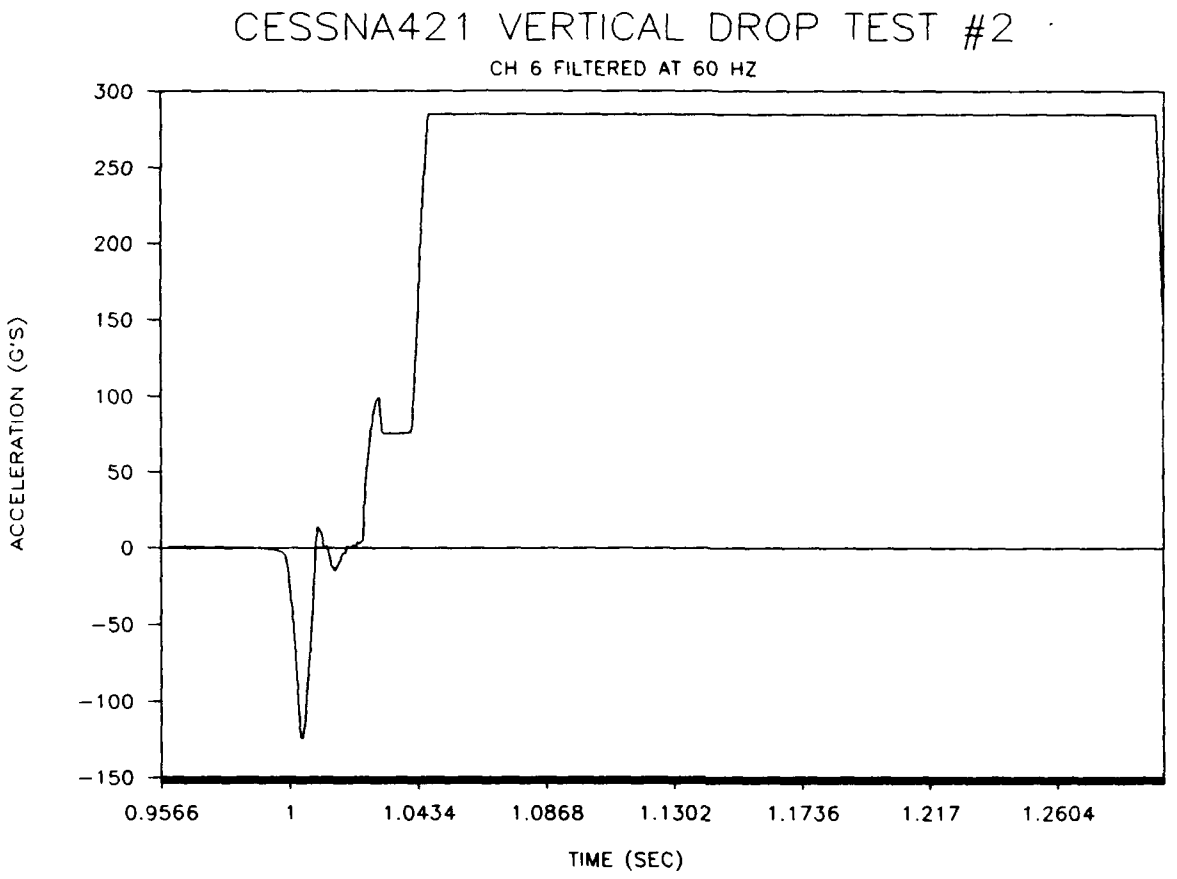

CESSNA421 VERTICAL DROP TEST #2
CH #26 COPILOT VGI
ACCELERATION (G'S)
10
0
-10
-20
-30
-40
-50
-60
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

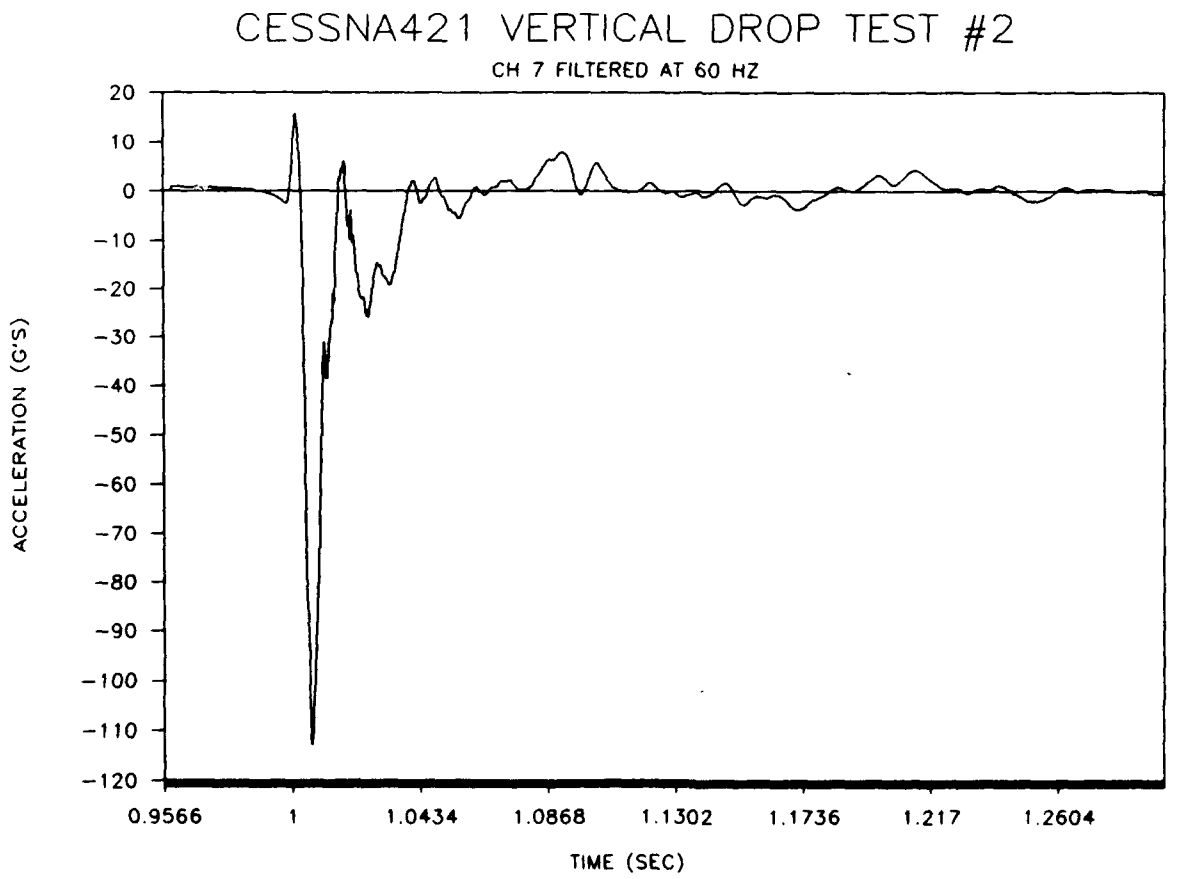

CESSNA421 VERTICAL DROP TEST #2
CH 29 REAR SEAT
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

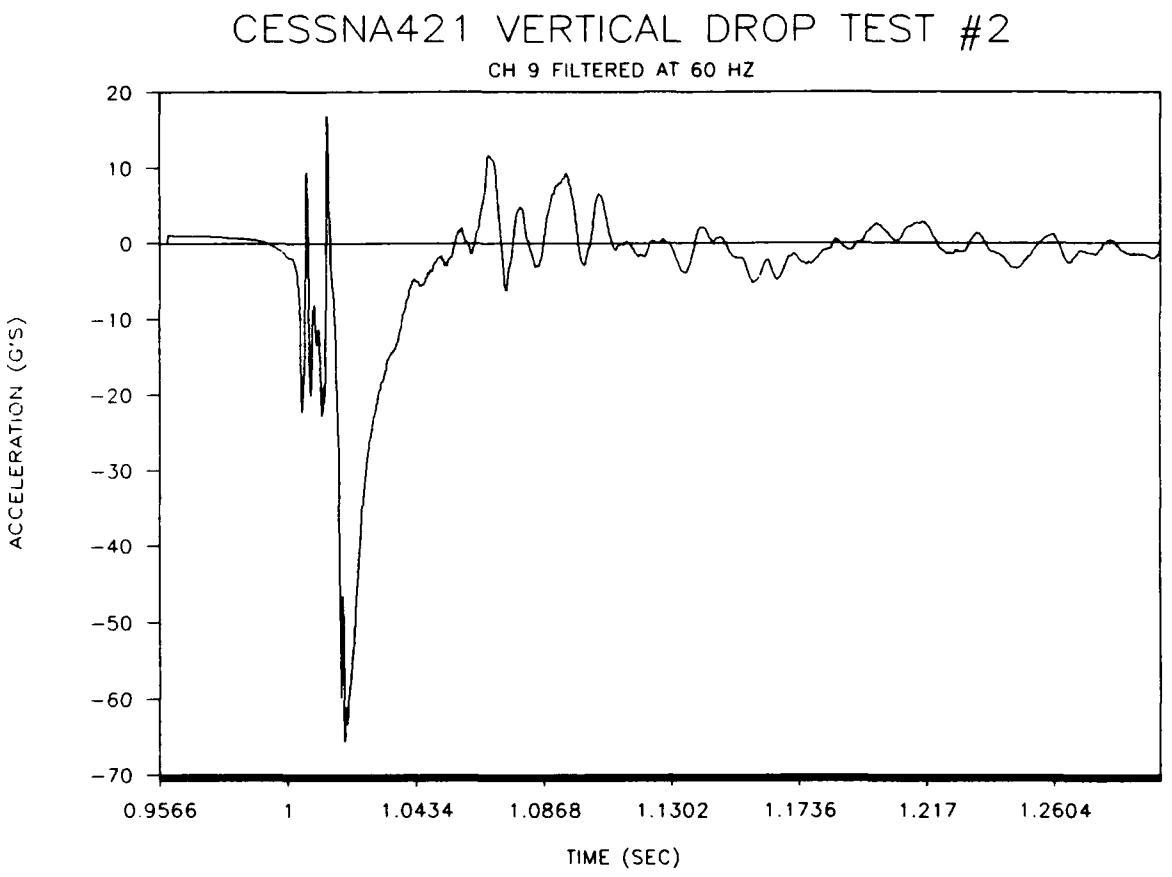

CESSNA421 VERTICAL DROP TEST #2
CH 30 CAMI ST. POT 1
DEFLECTION (INCHES)
6
5
4
3
2
1
0
−1
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

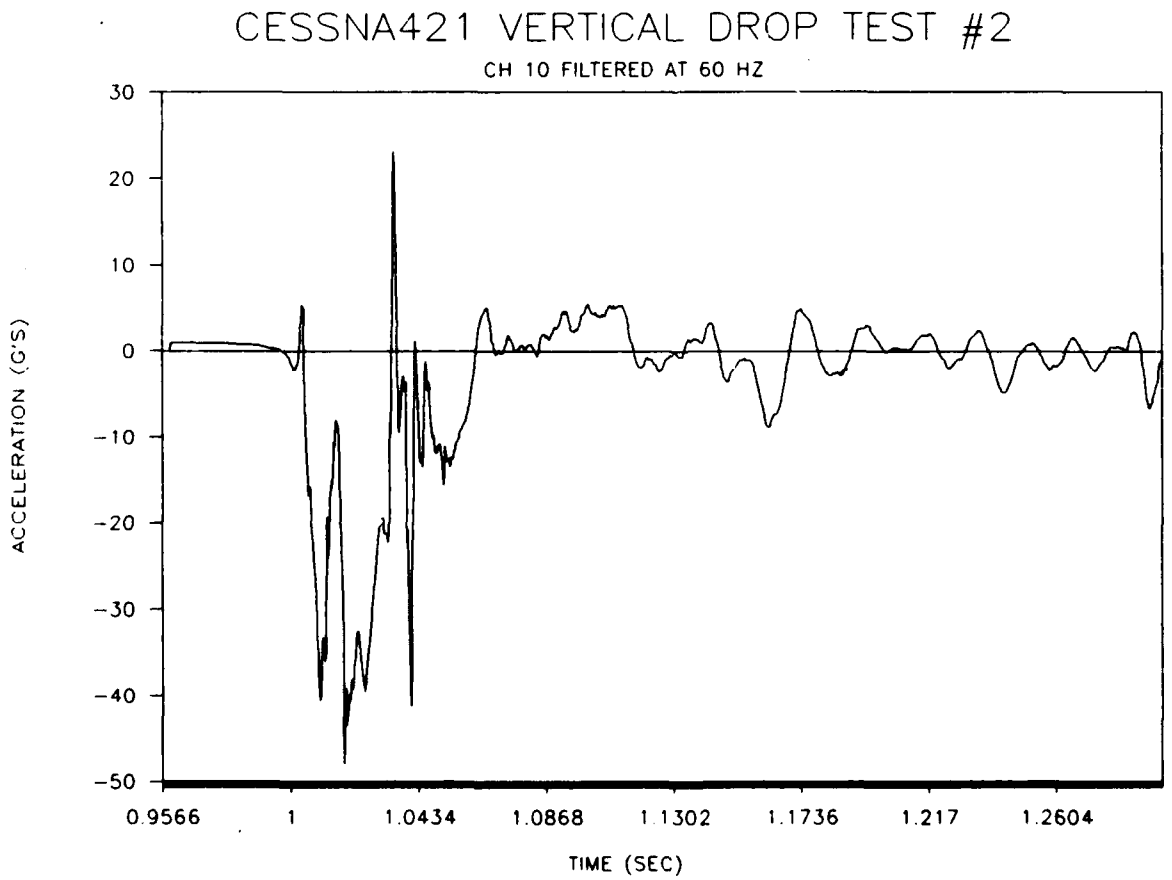

CESSNA421 VERTICAL DROP TEST #2
CH 2 FILTERED AT 60 HZ
ACCELERATION (G'S)
300
250
200
150
100
50
0
-50
-100
-150
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

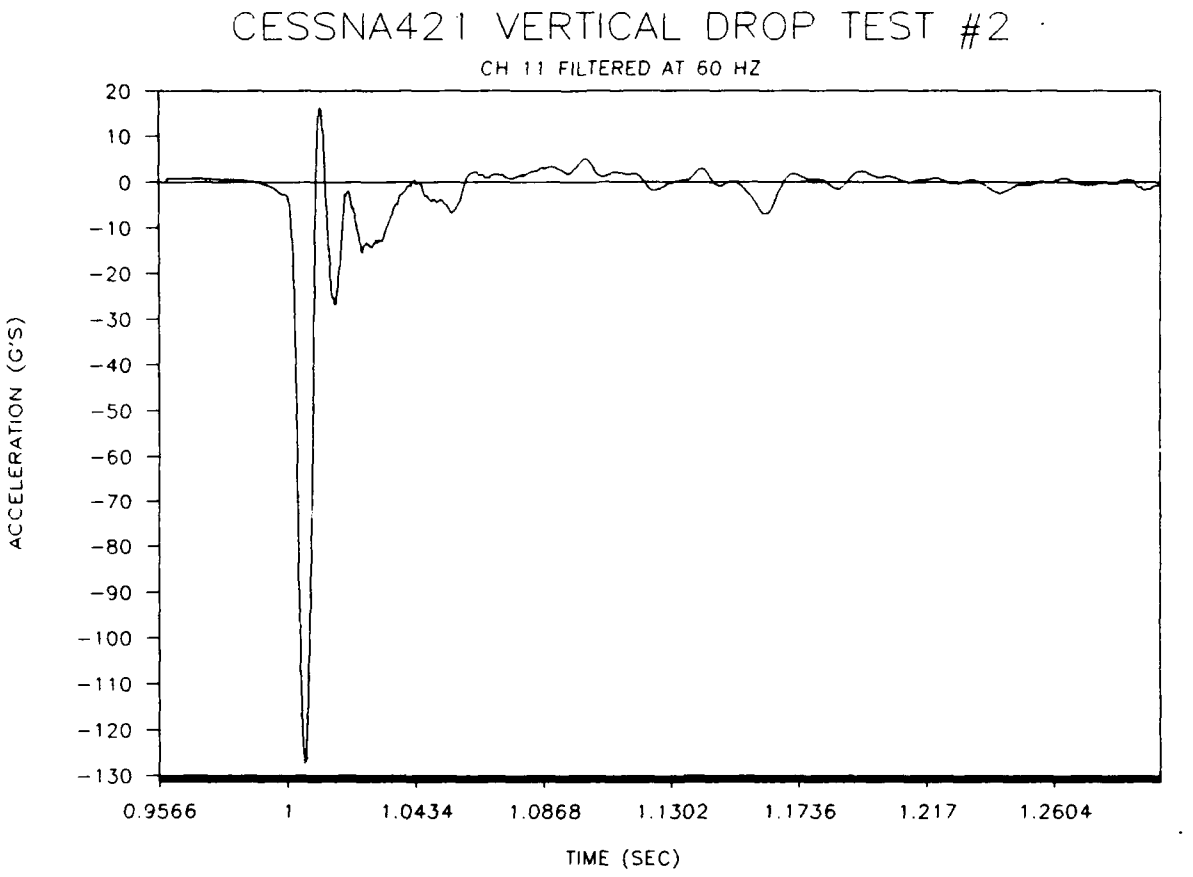

CESSNA421 VERTICAL DROP TEST #2
CH 5 FILTERED AT 60 HZ
ACCELERATION (G'S)
300
200
100
0
-100
-200
-300
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

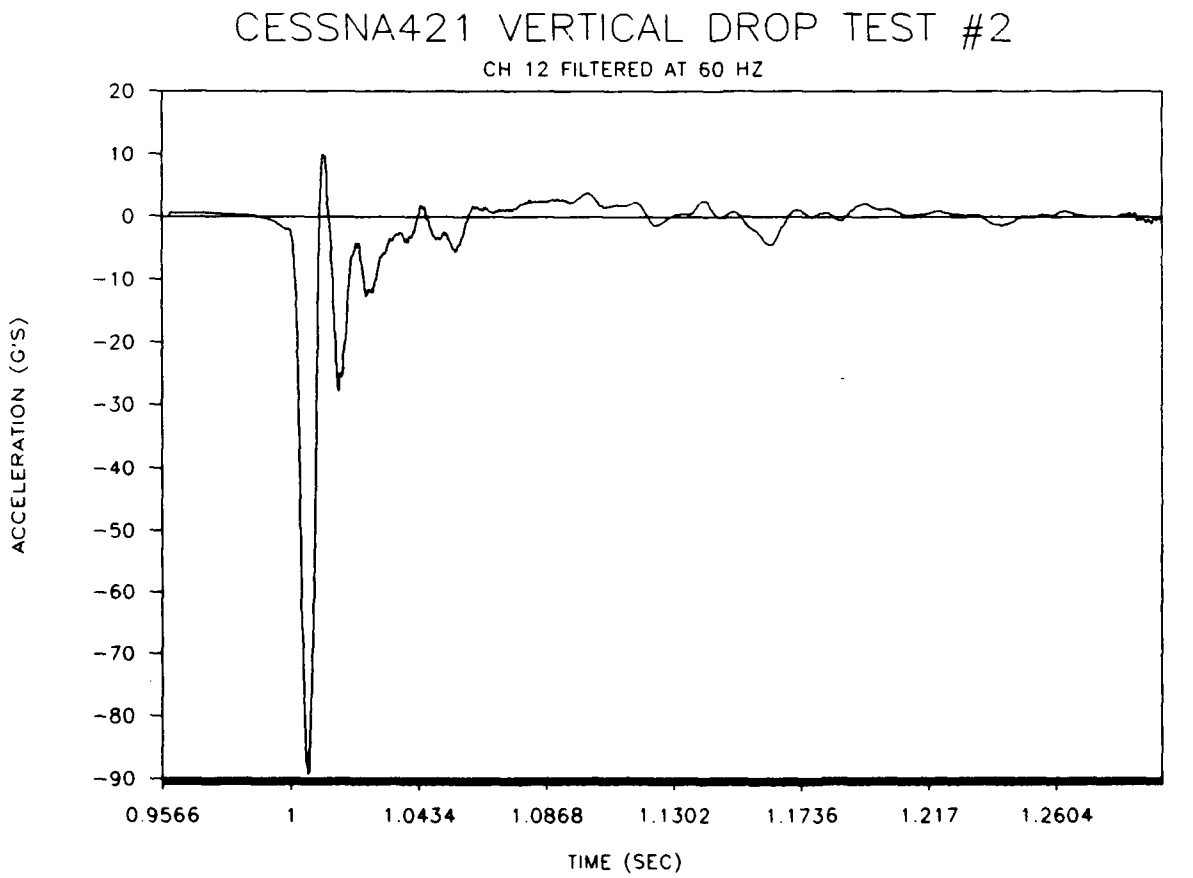

CESSNA421 VERTICAL DROP TEST #2
CH 6 FILTERED AT 60 HZ
ACCELERATION (G'S)
300
250
200
150
100
50
0
-50
-100
-150
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

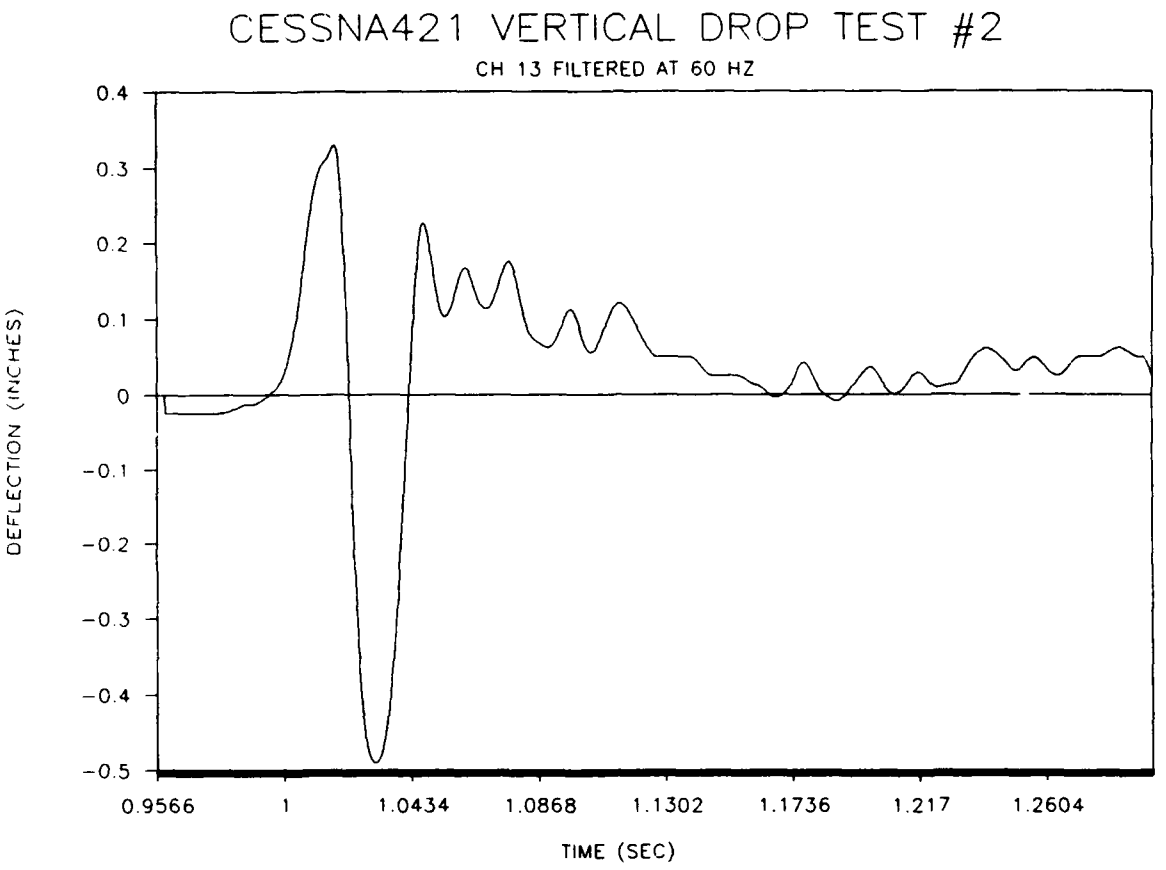

CESSNA421 VERTICAL DROP TEST #2
CH 7 FILTERED AT 60 HZ
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

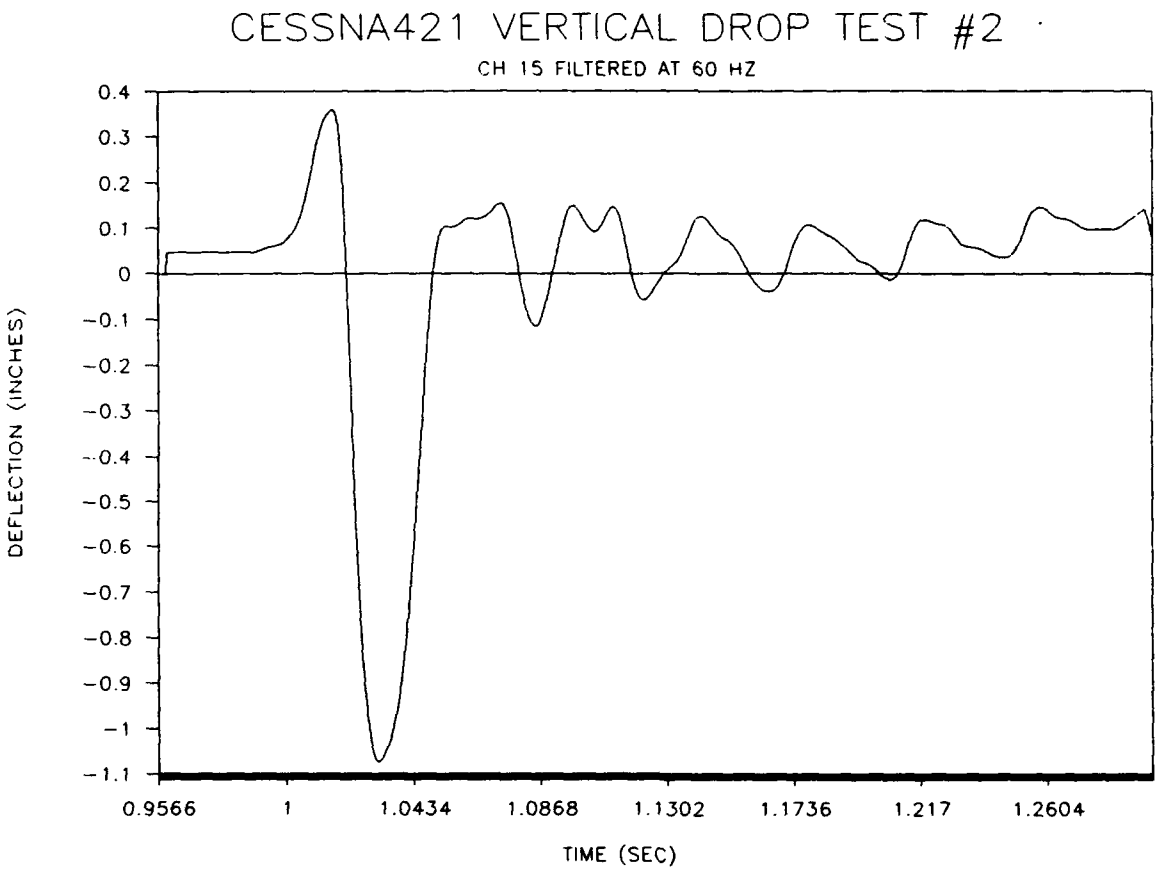

CESSNA421 VERTICAL DROP TEST #2
CH 9 FILTERED AT 60 HZ
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

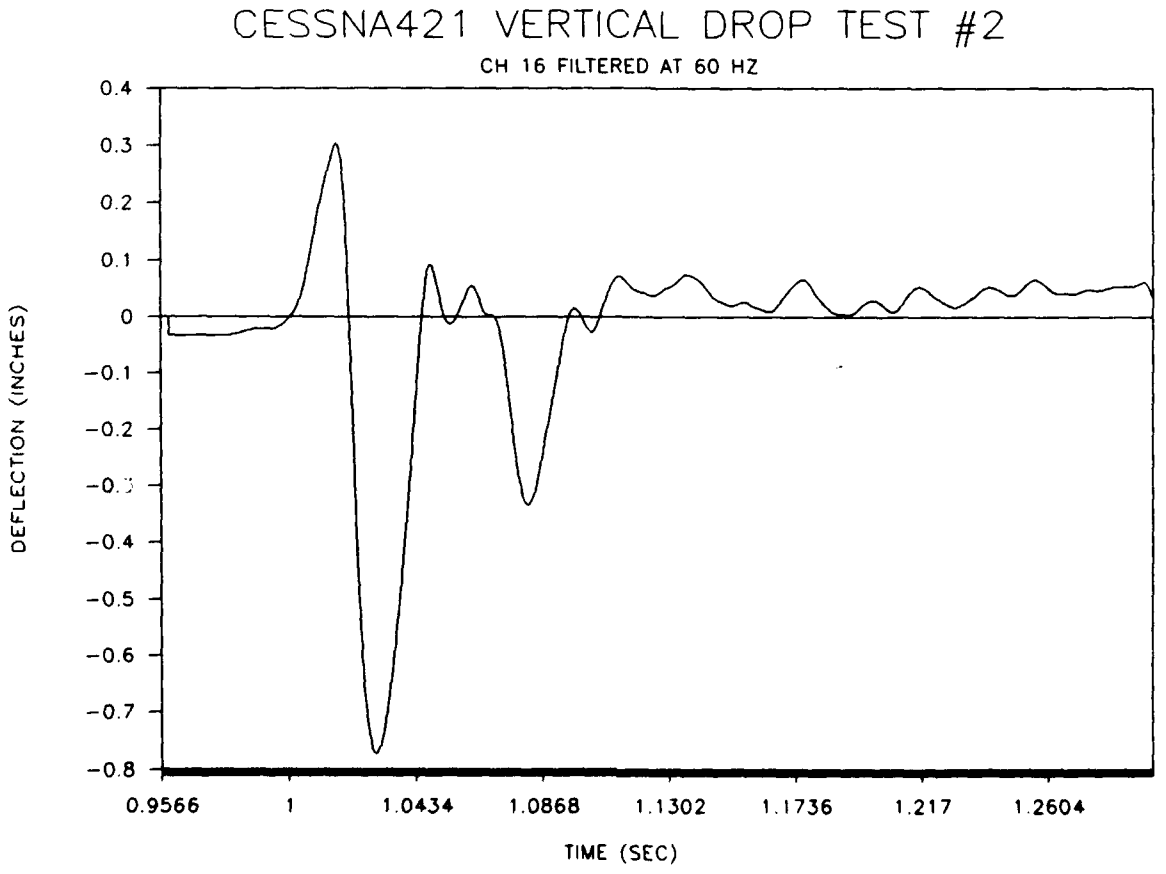

CESSNA421 VERTICAL DROP TEST #2
CH 10 FILTERED AT 60 HZ
ACCELERATION (G'S)
30
20
10
0
-10
-20
-30
-40
-50
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

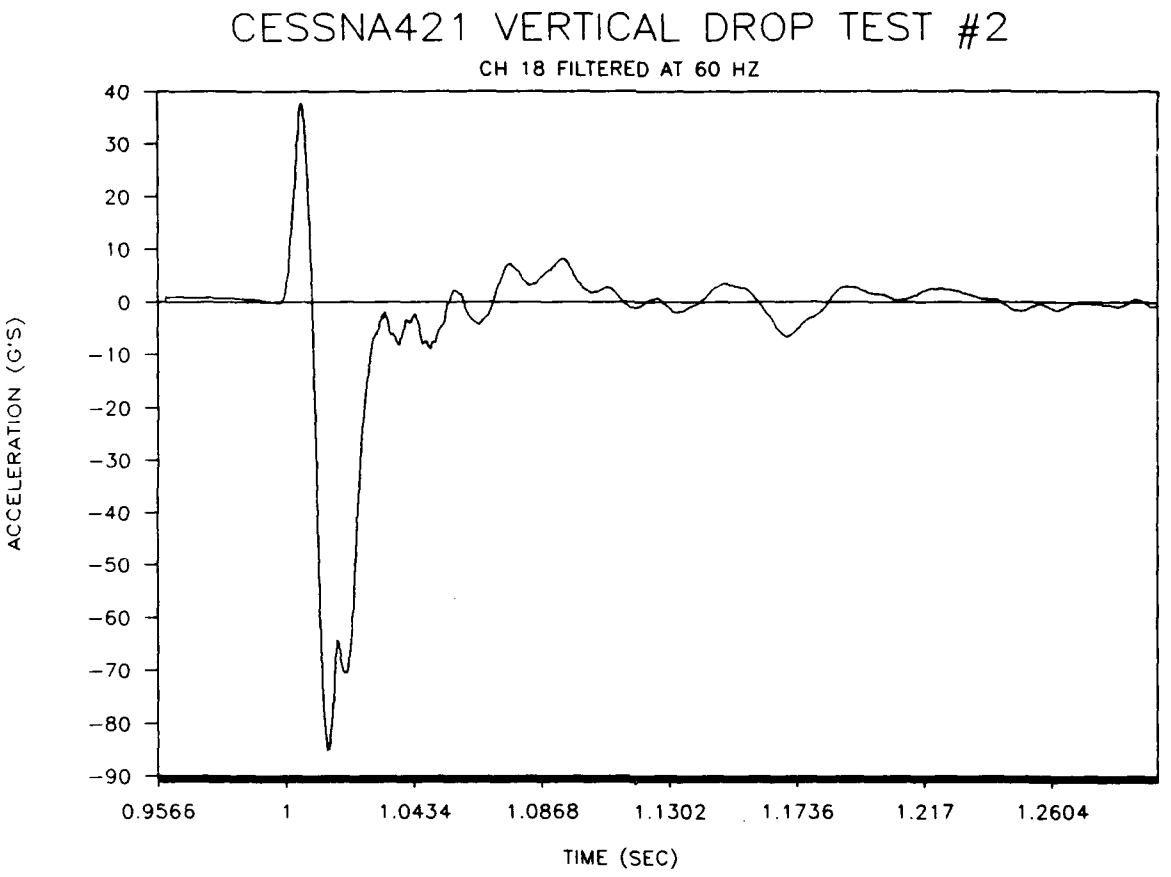

CESSNA421 VERTICAL DROP TEST #2
CH 11 FILTERED AT 60 HZ
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

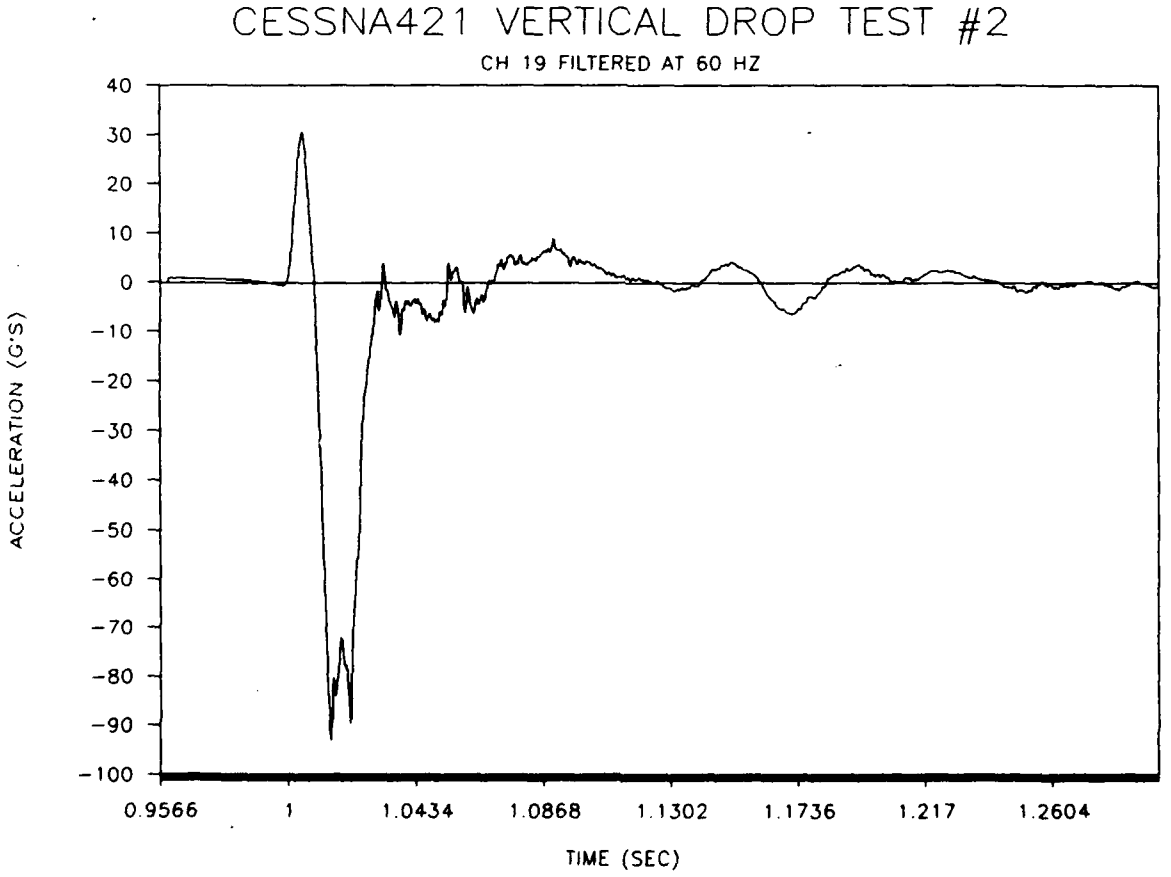

CESSNA421 VERTICAL DROP TEST #2
CH 12 FILTERED AT 60 HZ
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

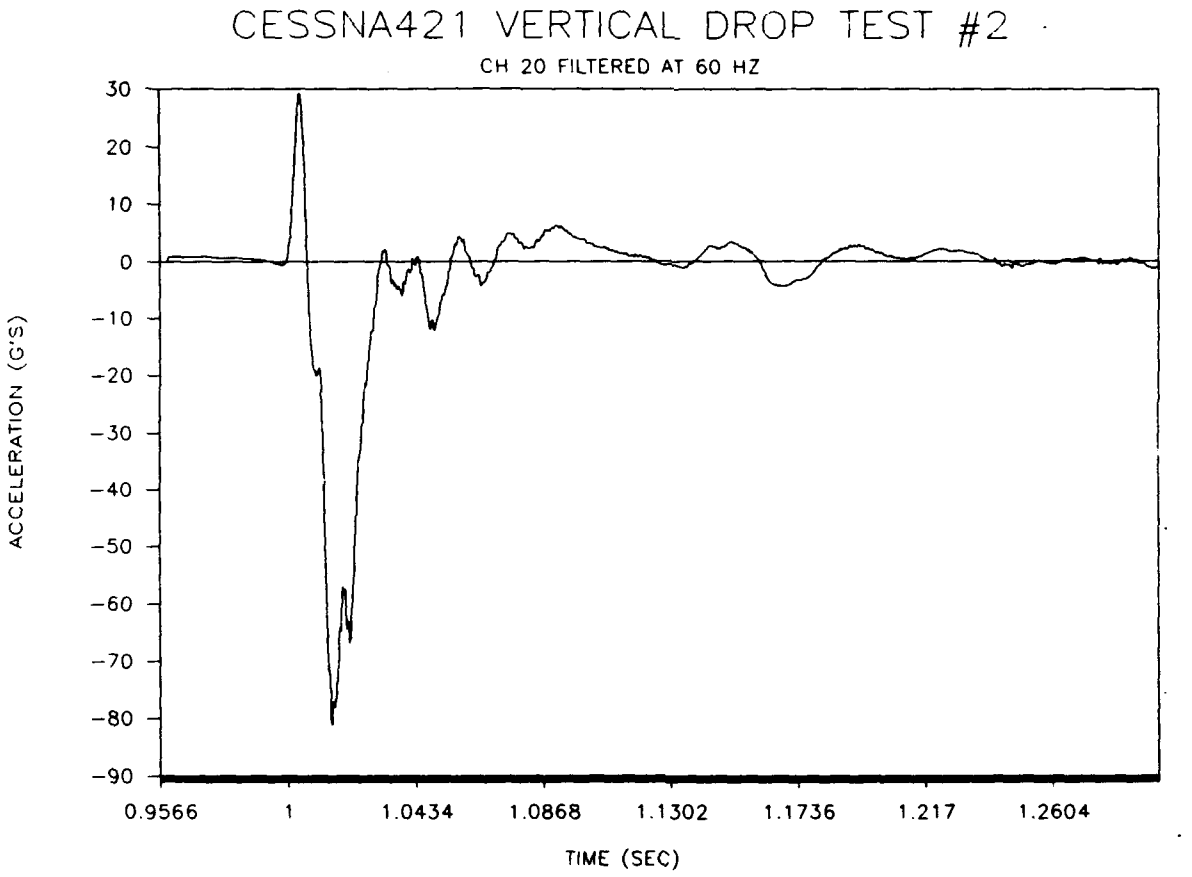

CESSNA421 VERTICAL DROP TEST #2
CH 13 FILTERED AT 60 HZ
DEFLECTION (INCHES)
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

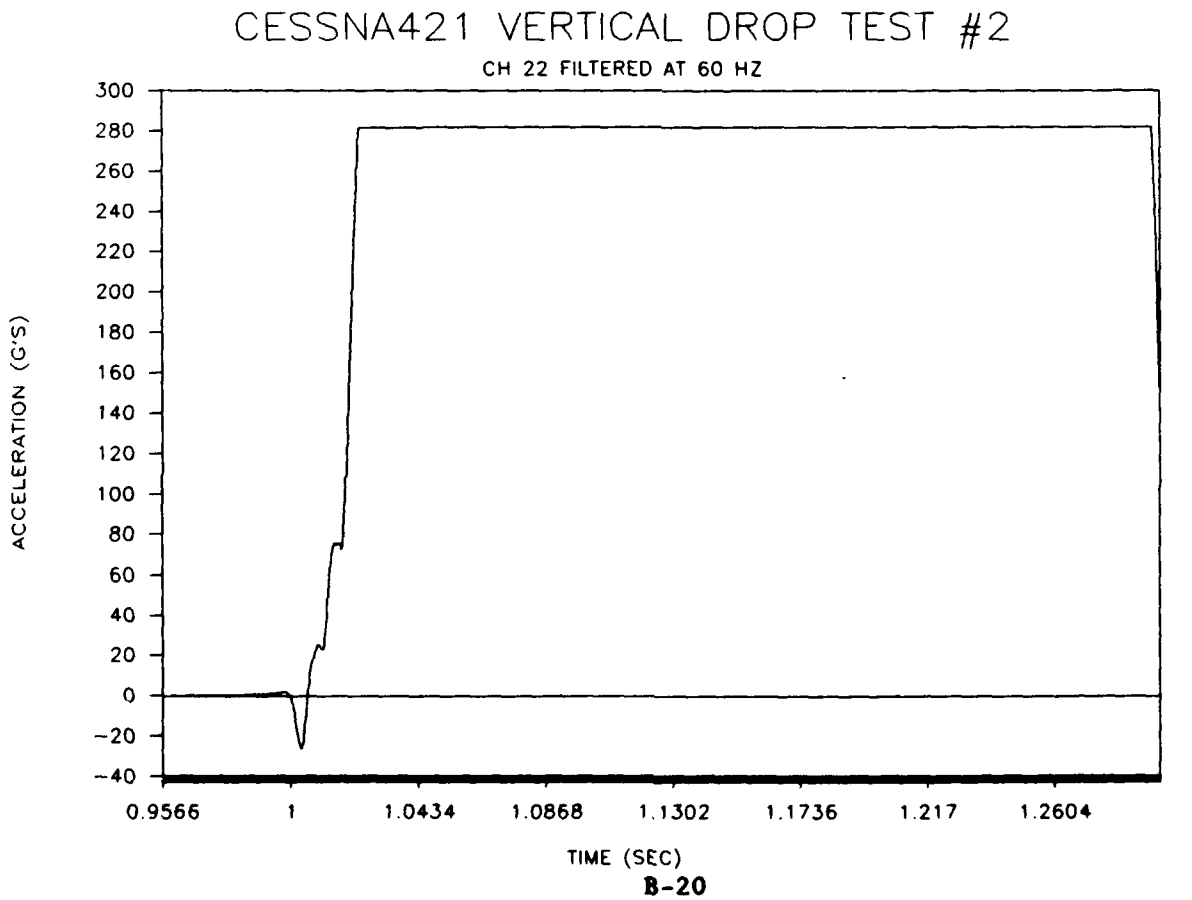

CESSNA421 VERTICAL DROP TEST #2
CH 15 FILTERED AT 60 HZ
DEFLECTION (INCHES)
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

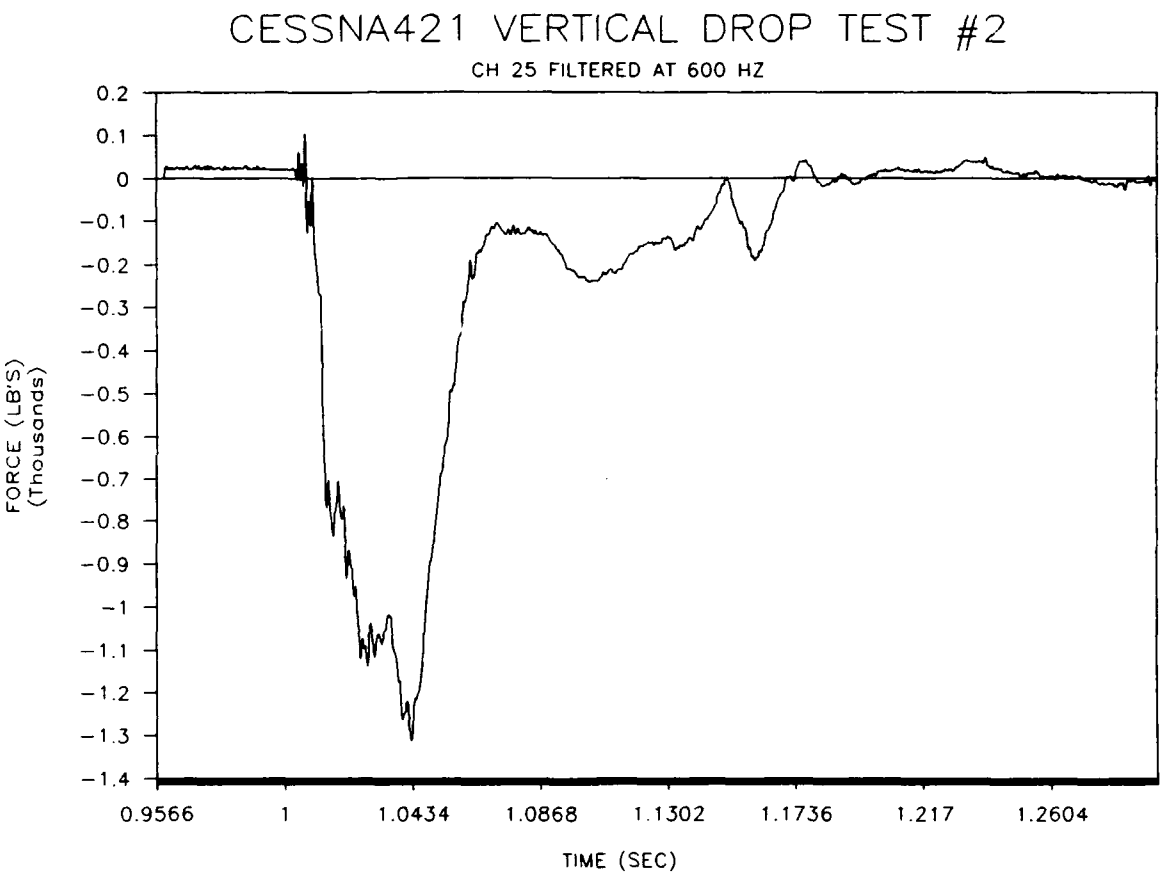

CESSNA421 VERTICAL DROP TEST #2
CH 16 FILTERED AT 60 HZ
DEFLECTION (INCHES)
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

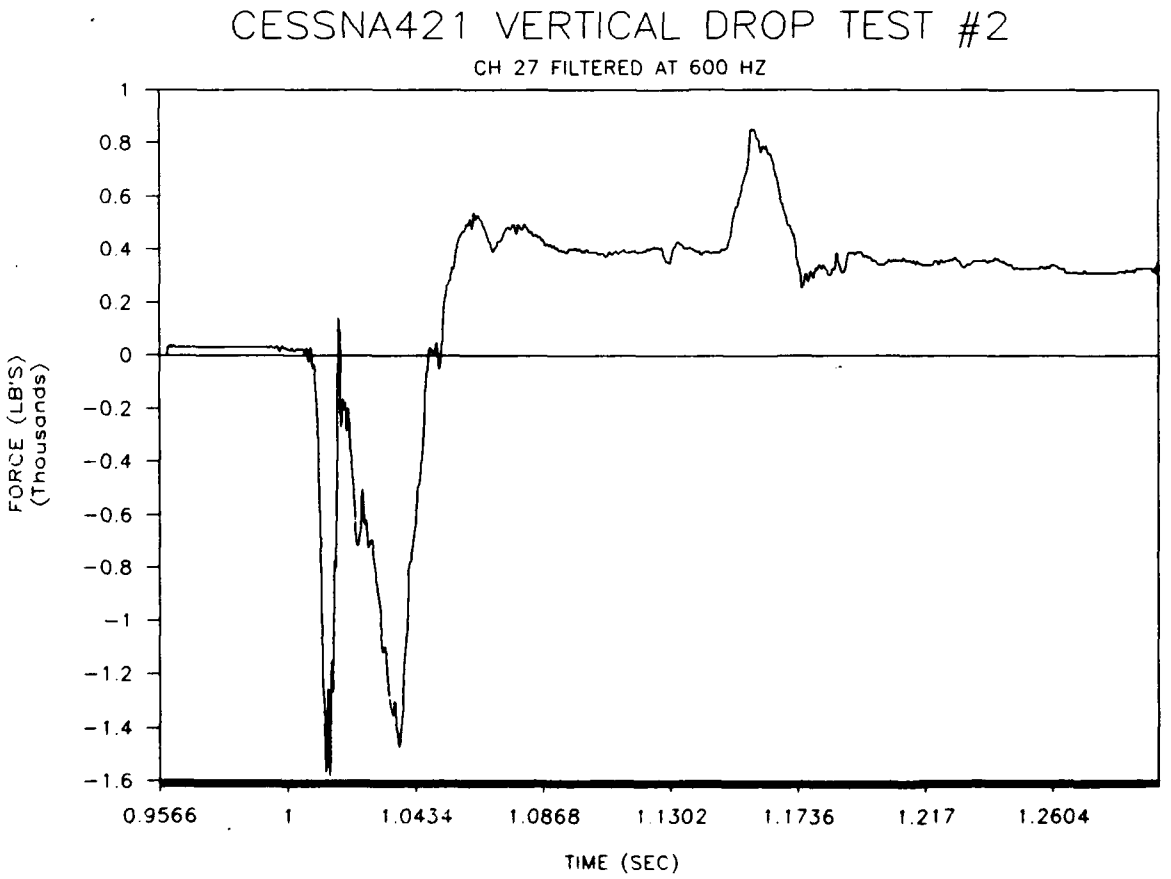

CESSNA421 VERTICAL DROP TEST #2
CH 18 FILTERED AT 60 HZ
ACCELERATION (G'S)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

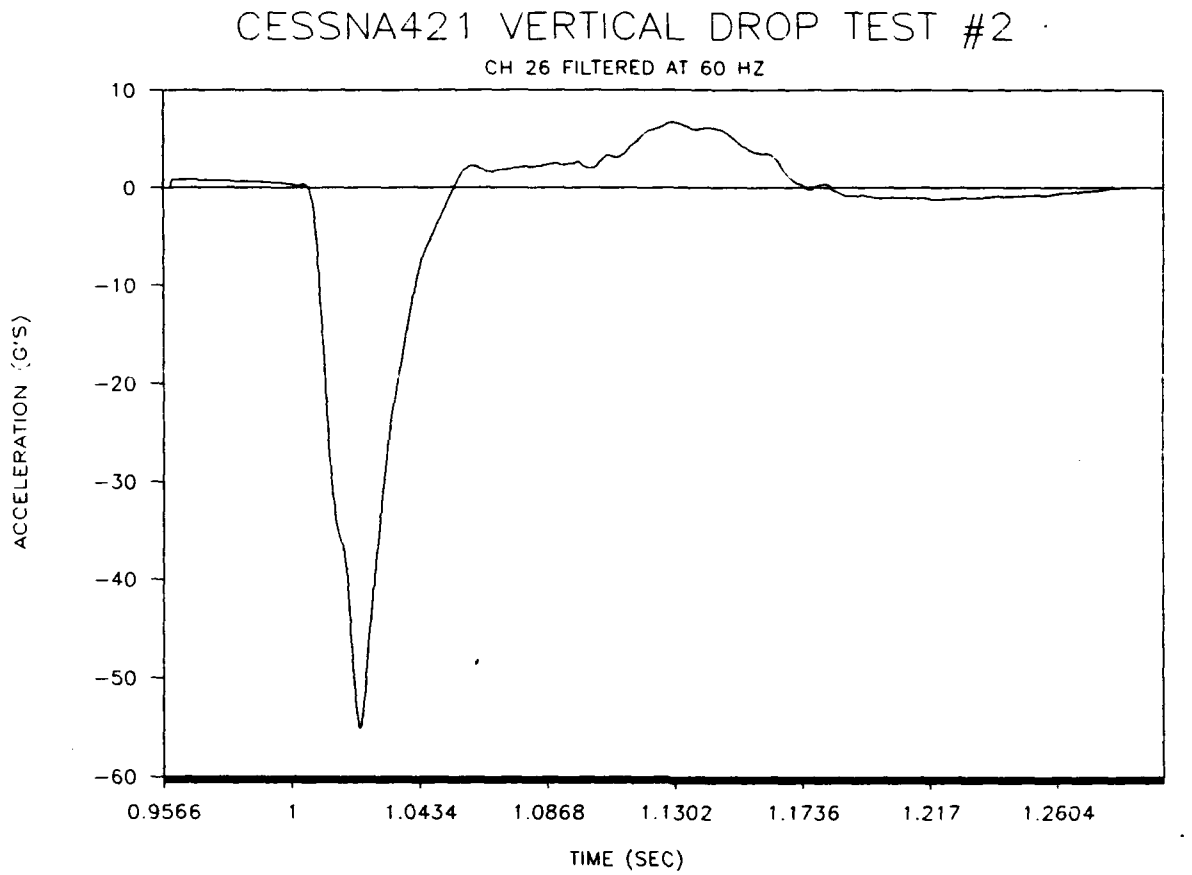

CESSNA421 VERTICAL DROP TEST #2
CH 19 FILTERED AT 60 HZ
ACCELERATION (G'S)
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

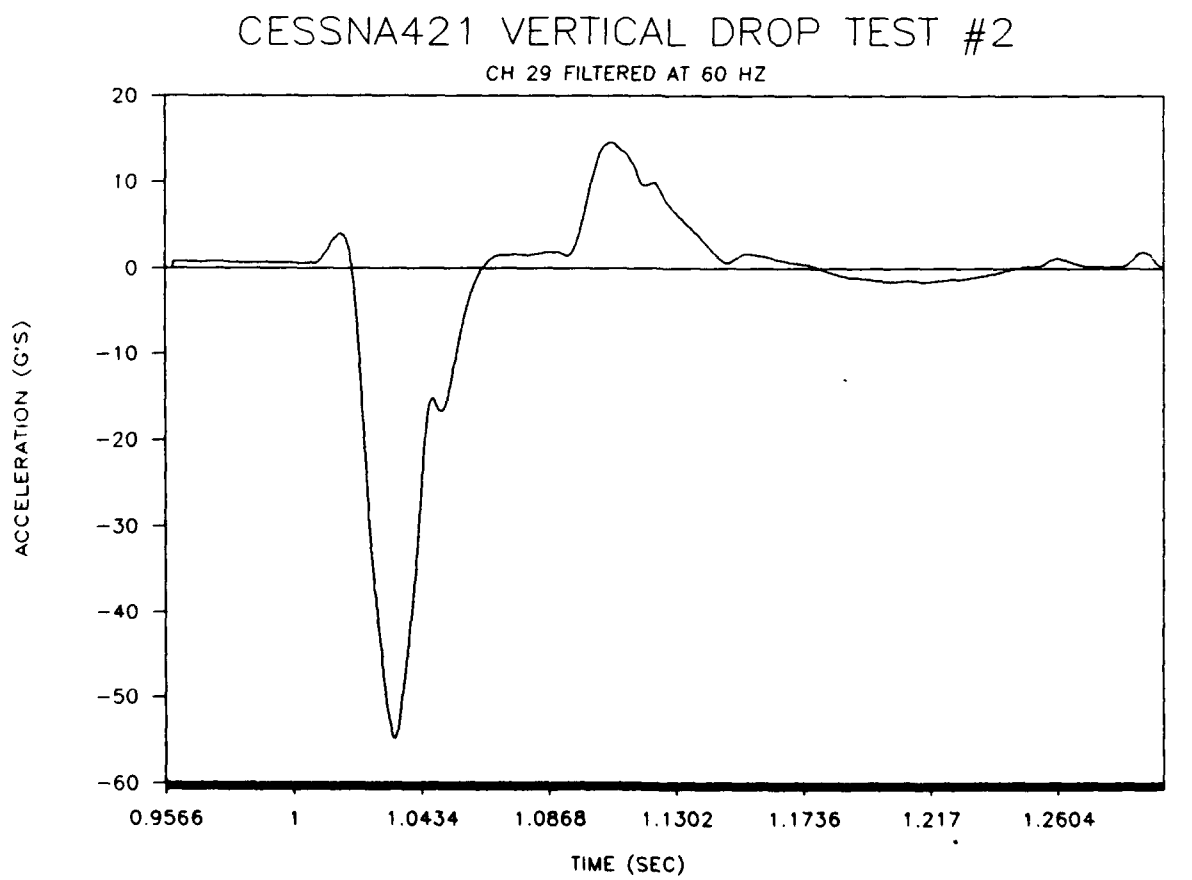

CESSNA421 VERTICAL DROP TEST #2
CH 20 FILTERED AT 60 HZ
ACCELERATION (G'S)
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

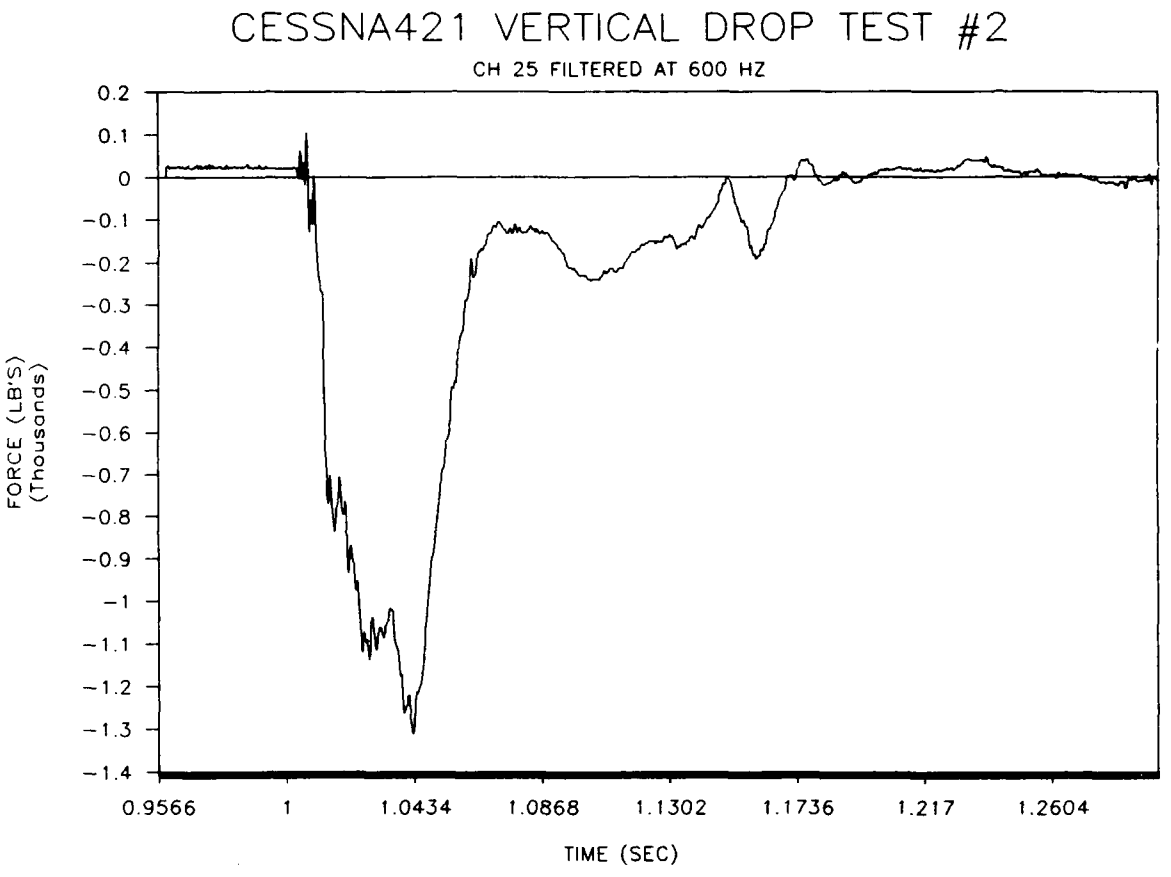

CESSNA421 VERTICAL DROP TEST #2
CH 22 FILTERED AT 60 HZ
ACCELERATION (G'S)
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-20
-40
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

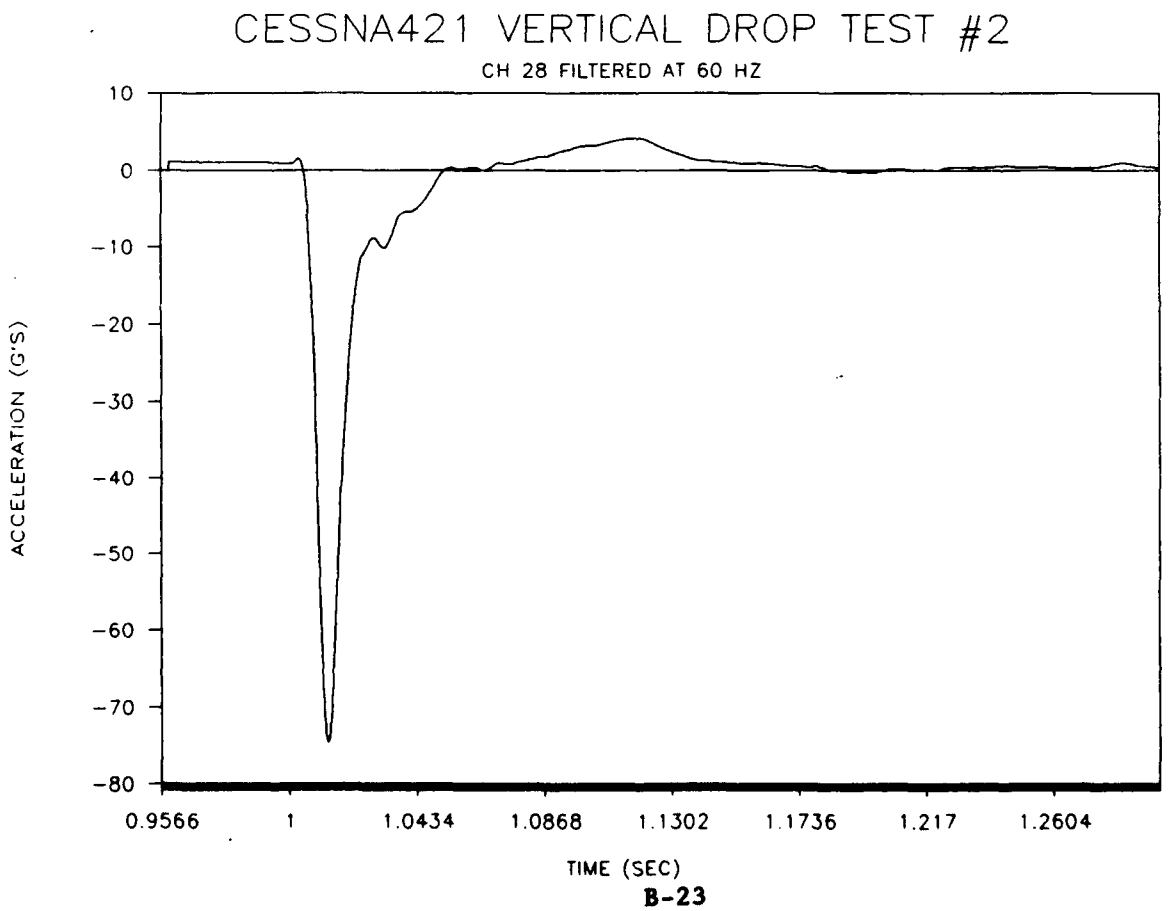

CESSNA421 VERTICAL DROP TEST #2
CH 25 FILTERED AT 600 HZ
FORCE (LB'S)
(Thousands)
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

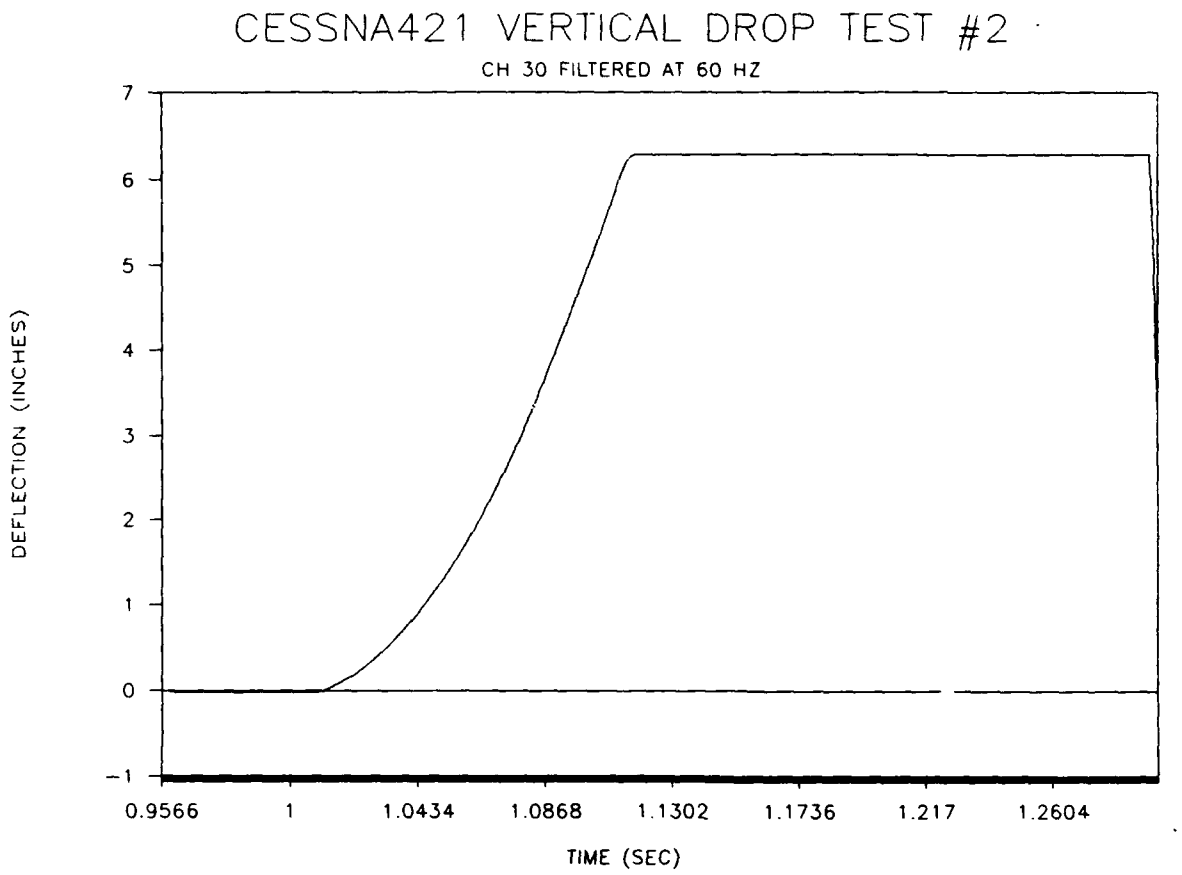

CESSNA421 VERTICAL DROP TEST #2
CH 27 FILTERED AT 600 HZ
FORCE (LB'S)
(Thousands)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)


CESSNA421 VERTICAL DROP TEST #2
CH 26 FILTERED AT 60 HZ
ACCELERATION (G'S)
10
0
-10
-20
-30
-40
-50
-60
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

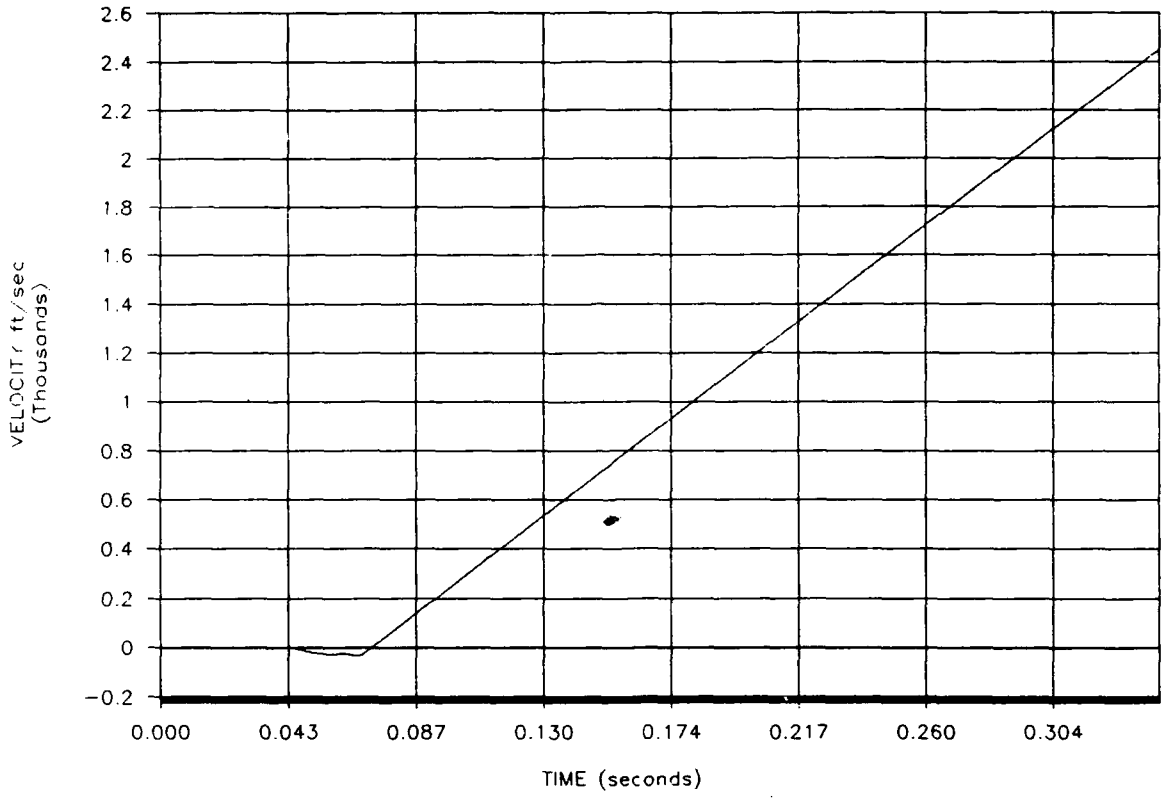

CESSNA421 VERTICAL DROP TEST #2
CH 29 FILTERED AT 60 HZ
ACCELERATION (G'S)
20
10
0
-10
-20
-30
-40
-50
-60
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)


CESSNA421 VERTICAL DROP TEST #2
CH 25 FILTERED AT 600 HZ
FORCE (LB'S)
(Thousands)
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

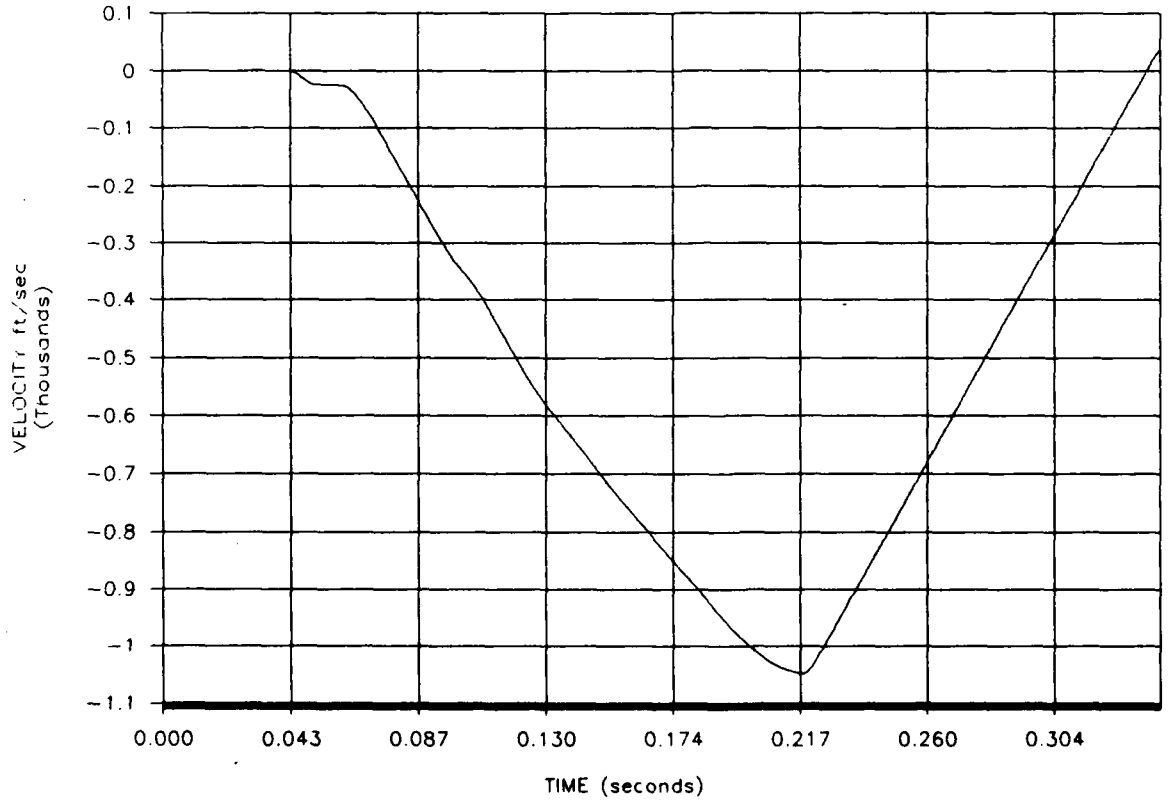

CESSNA421 VERTICAL DROP TEST #2
CH 28 FILTERED AT 60 HZ
ACCELERATION (G'S)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)


CESSNA421 VERTICAL DROP TEST #2
CH 30 FILTERED AT 60 HZ
DEFLECTION (INCHES)
7
6
5
4
3
2
1
0
-1
0.9566
1
1.0434
1.0868
1.1302
1.1736
1.217
1.2604
TIME (SEC)

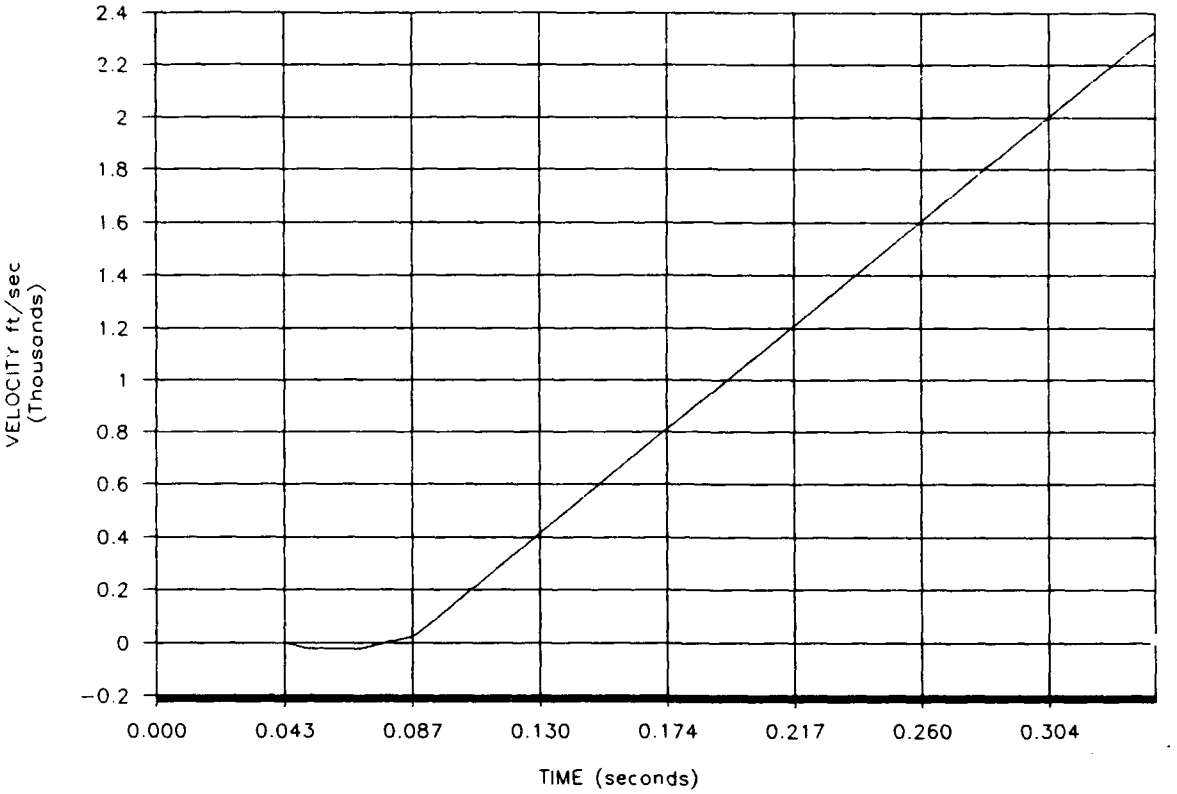
CH 2


2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
VELOCITY ft/sec
(Thousands)
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

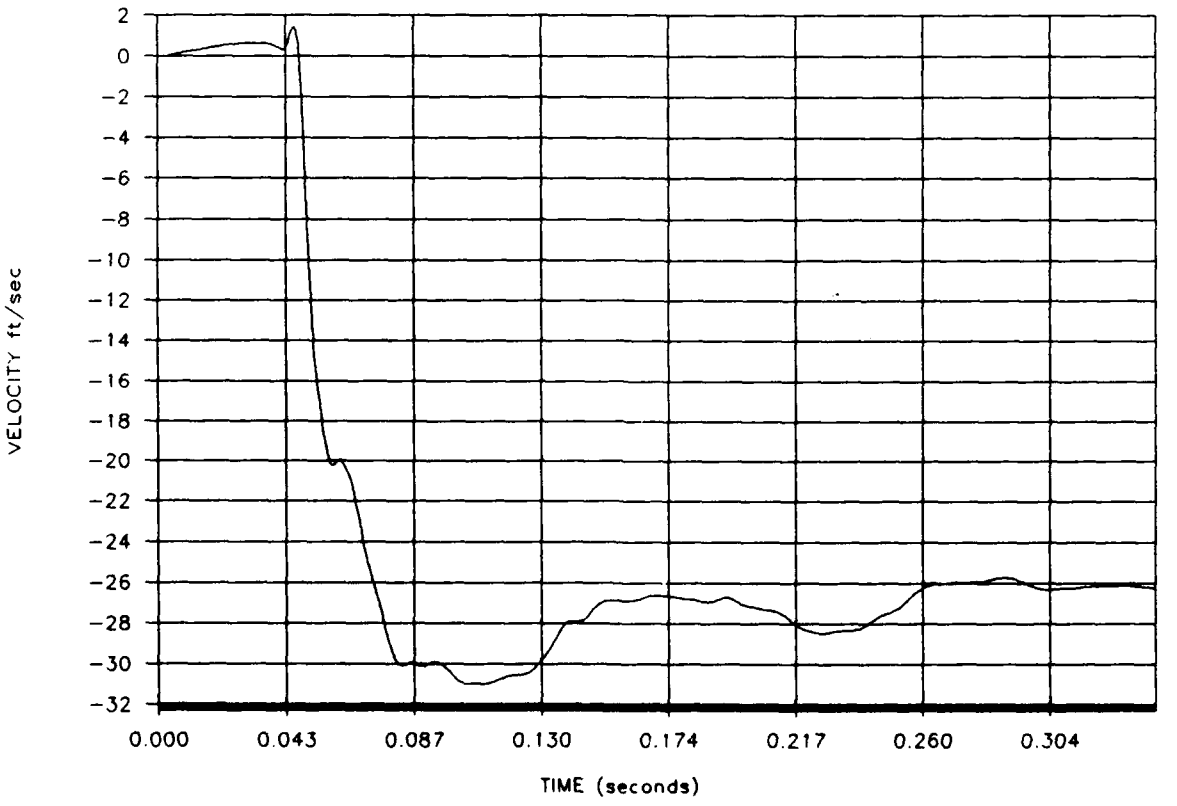
CH 5


0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
VELOCITY ft/sec
(Thousands)
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

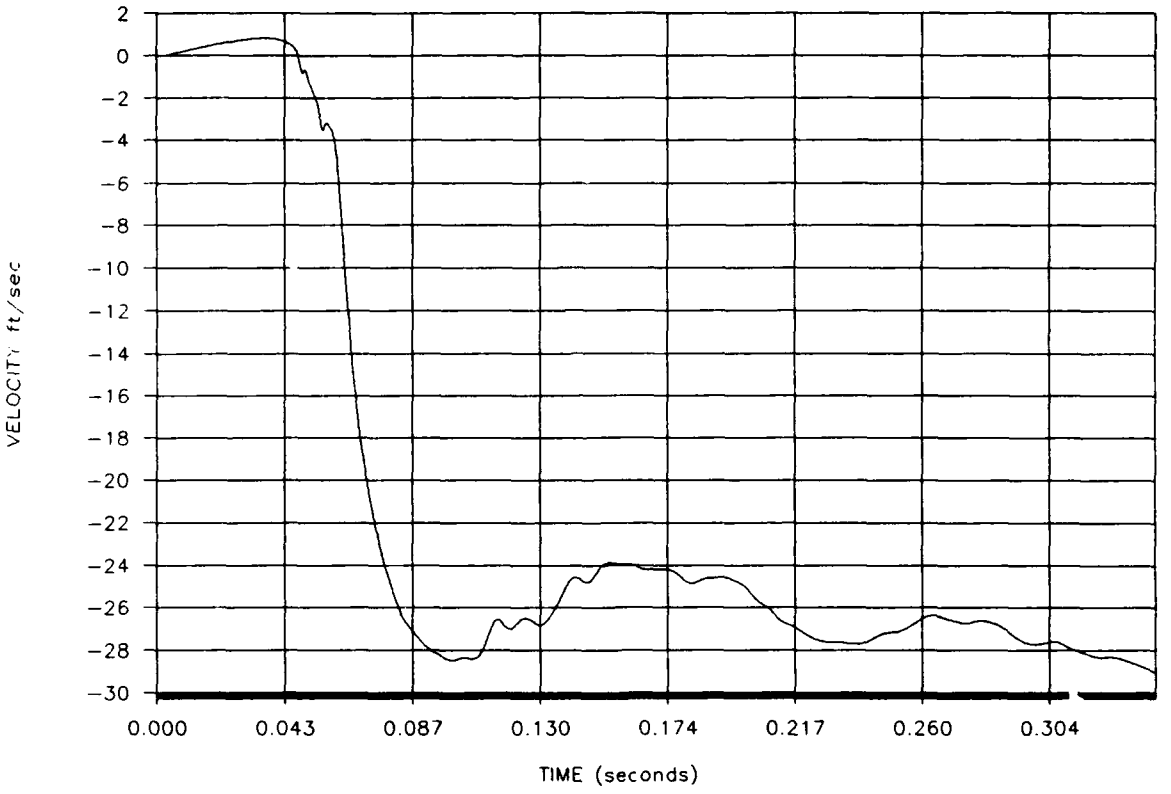
CH 6


VELOCITY ft/sec
(Thousands)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

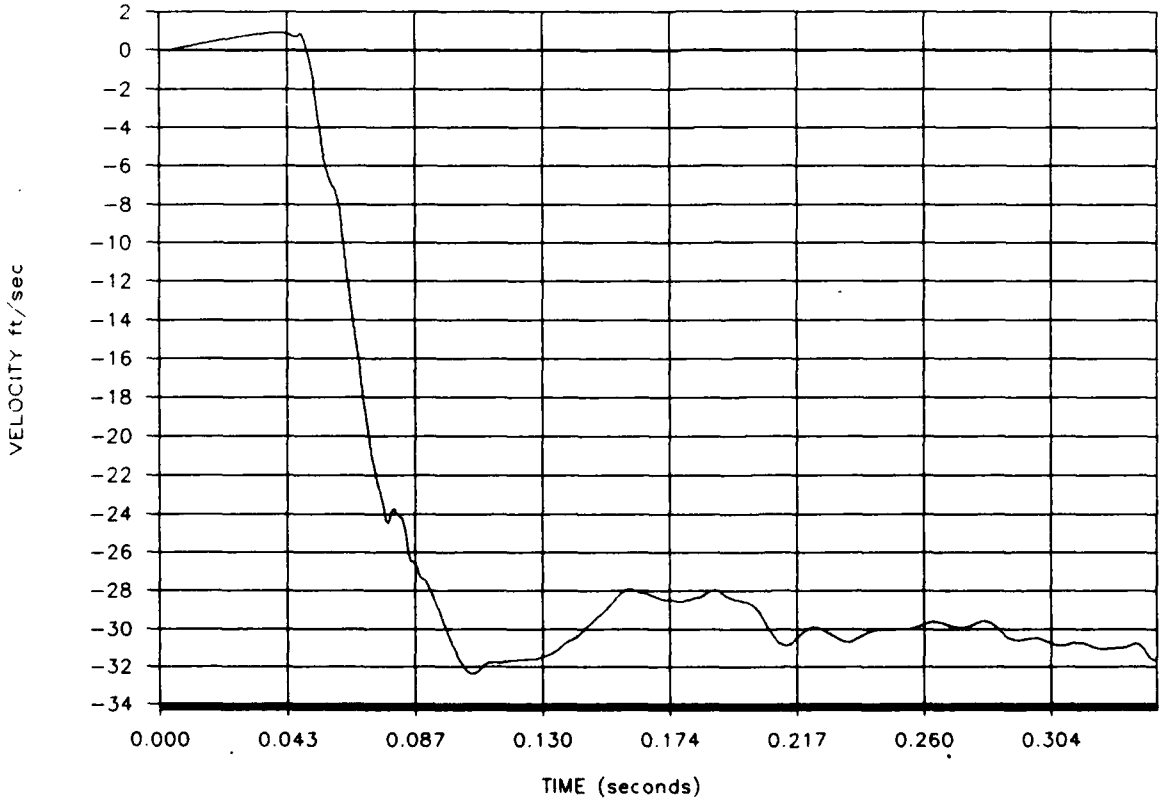
CH 7


VELOCITY ft/sec
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

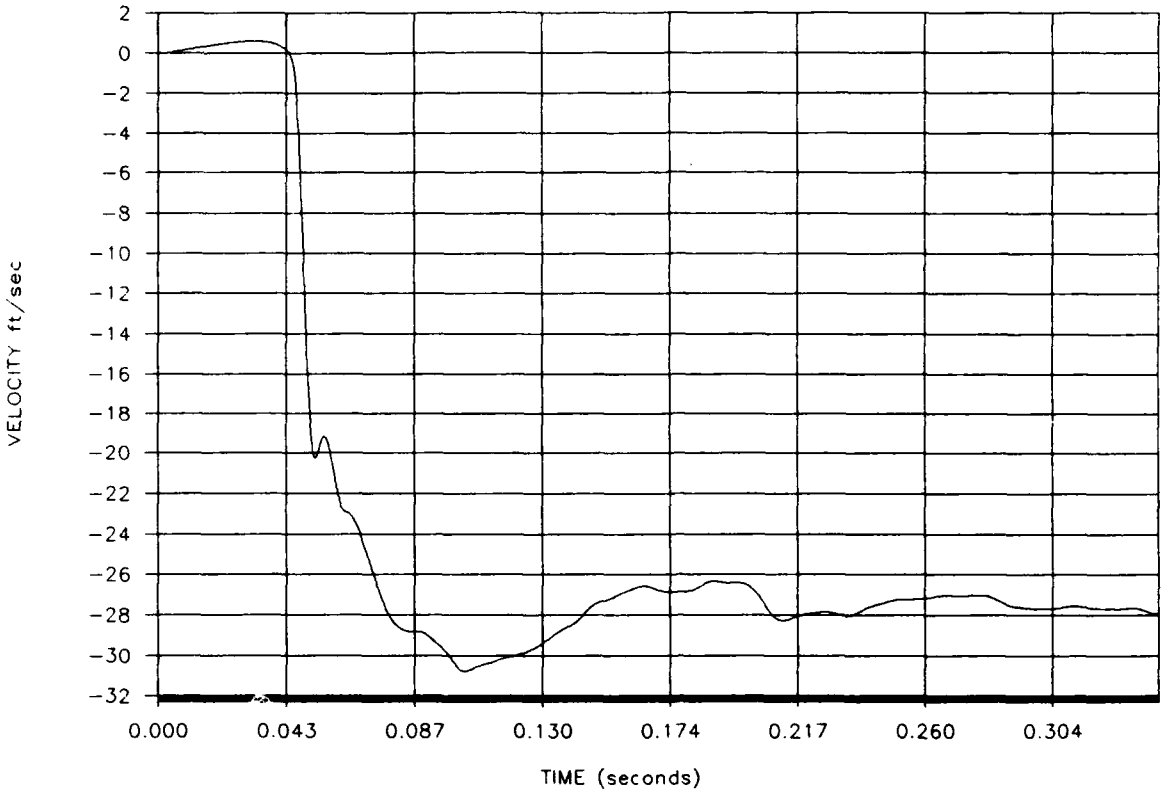
CH 9


2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
VELOCITY ft/sec
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

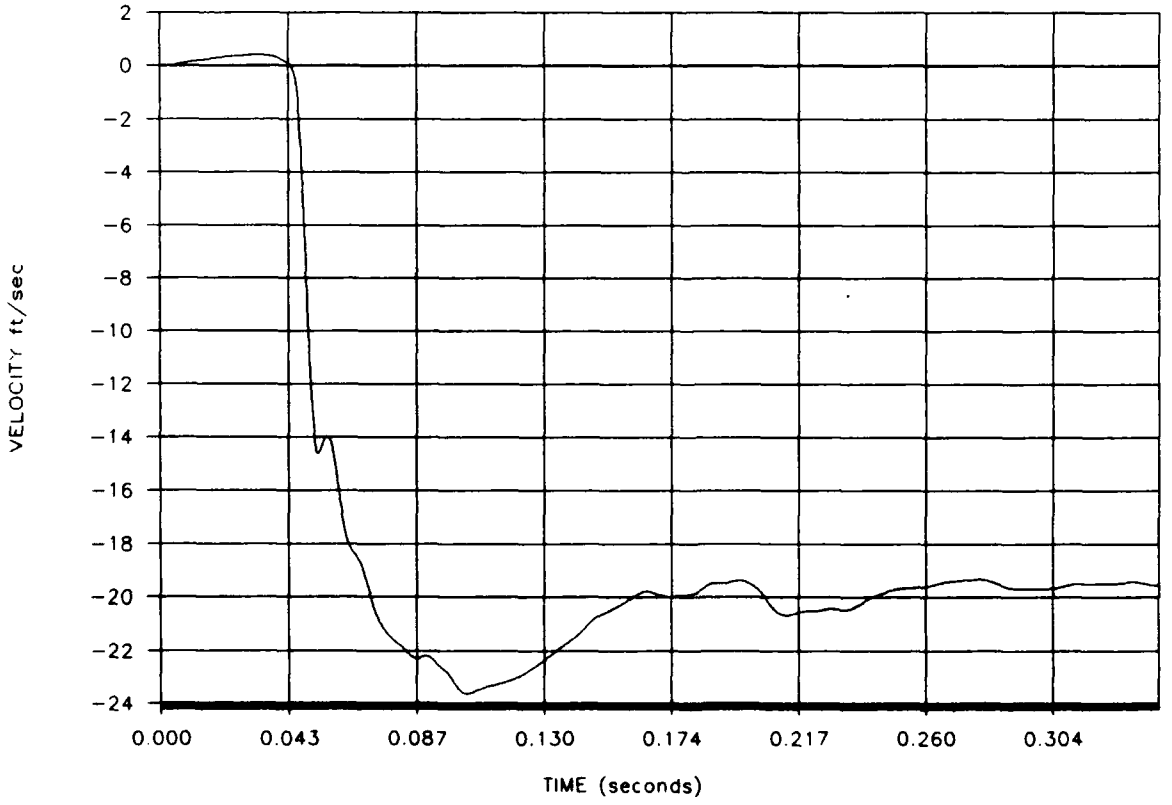
CH 10


2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
VELOCITY ft/sec
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

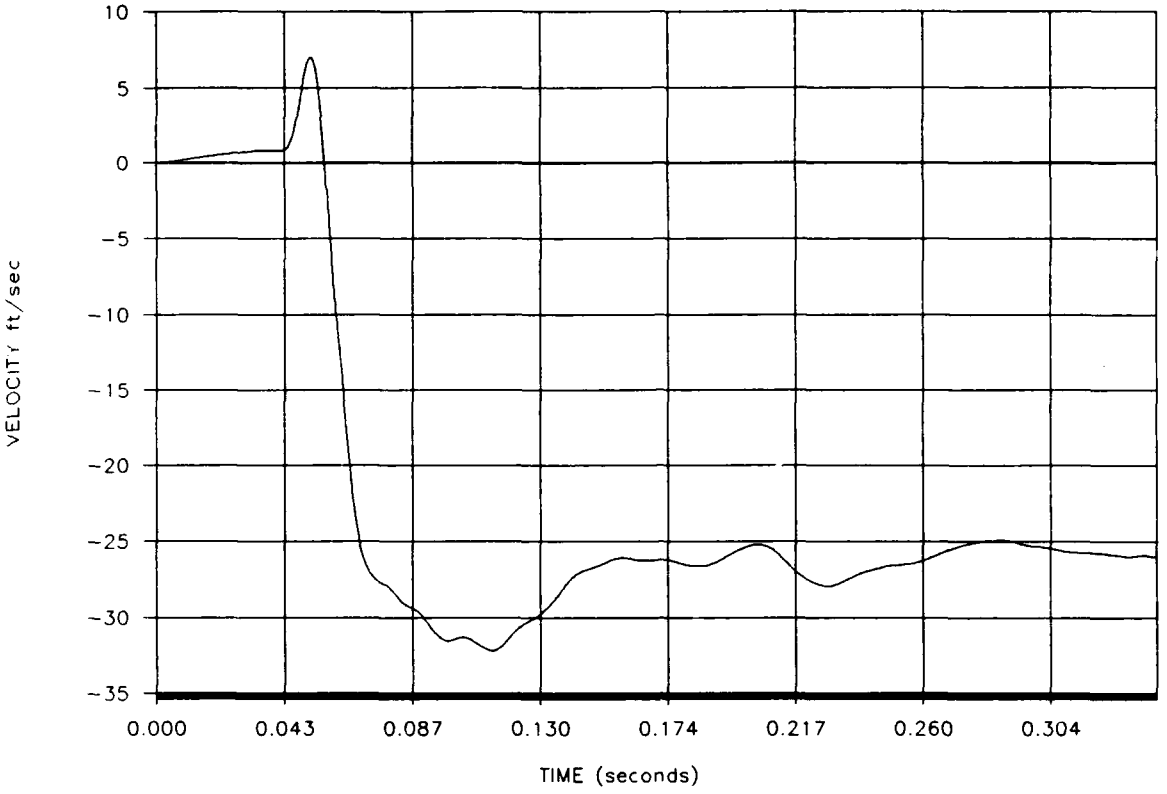
CH 11


VELOCITY ft/sec
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

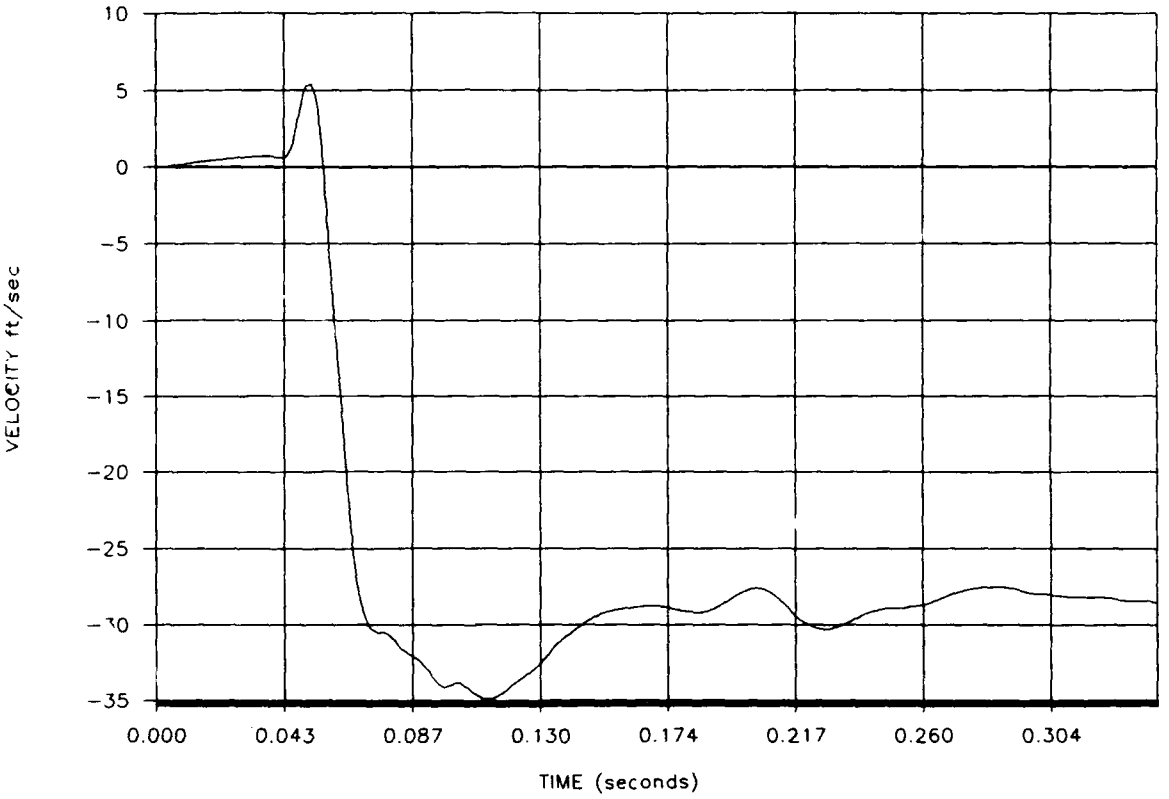
CH 12


VELOCITY ft/sec
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

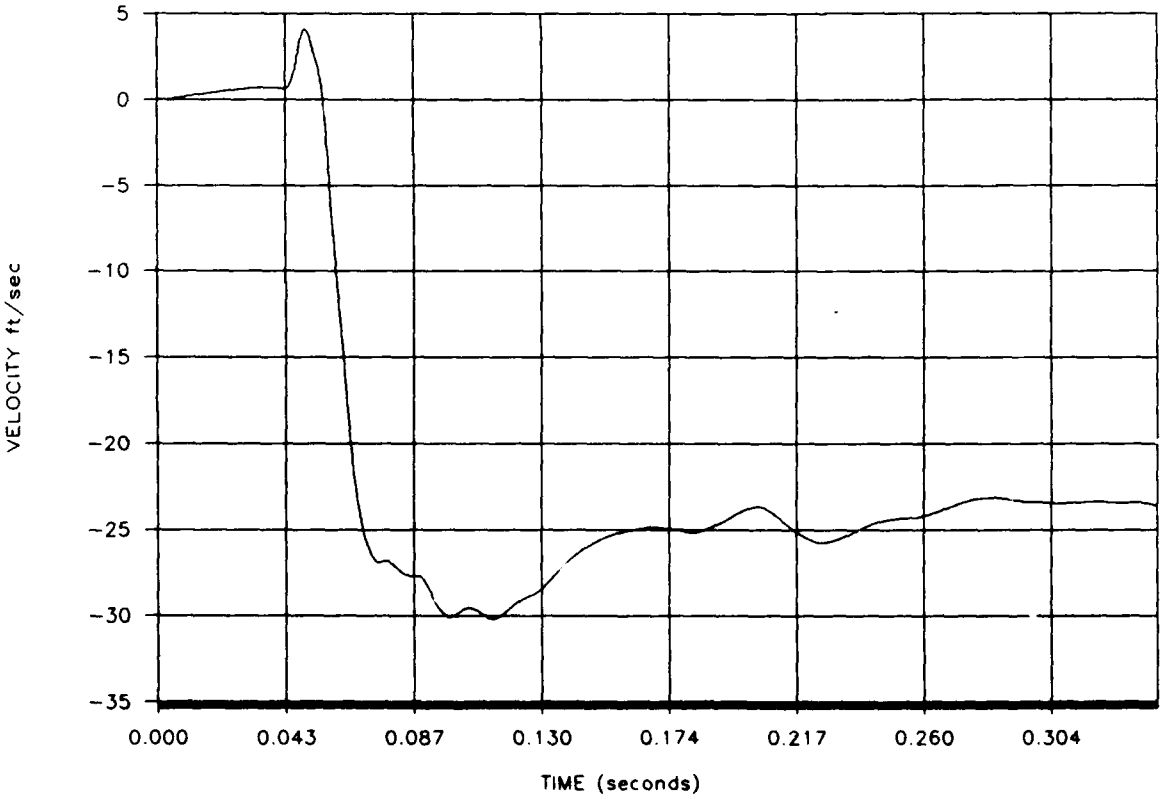
CH 18


10
5
0
-5
-10
-15
-20
-25
-30
-35
VELOCITY ft/sec
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

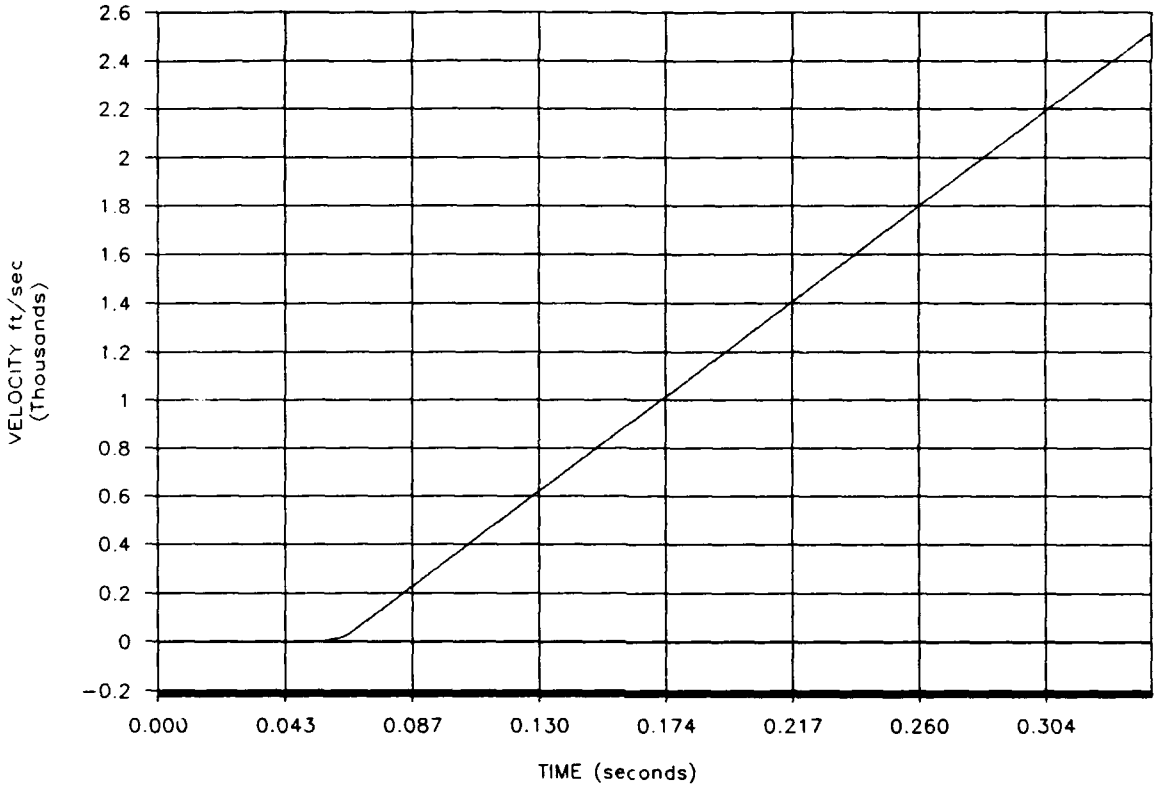
CH 19


10
5
0
-5
-10
-15
-20
-25
-30
-35
VELOCITY ft/sec
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

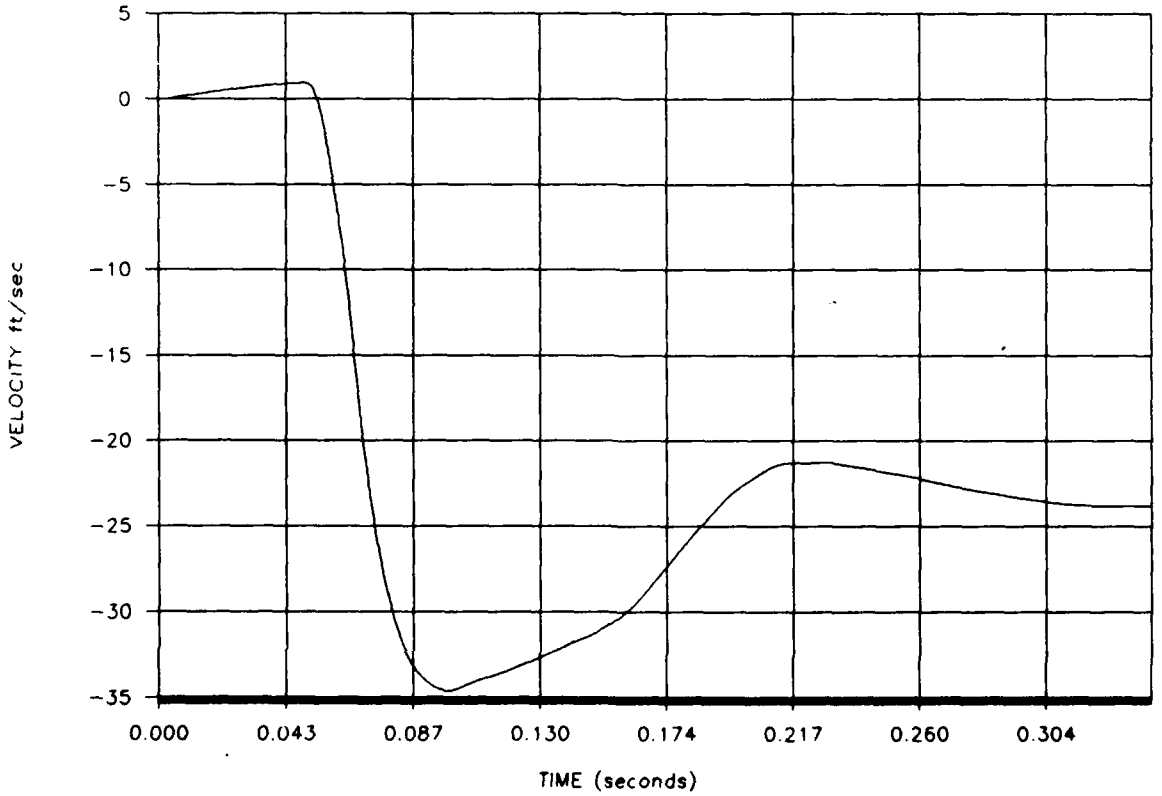
CH 20


5
0
-5
-10
-15
-20
-25
-30
-35
VELOCITY ft/sec
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

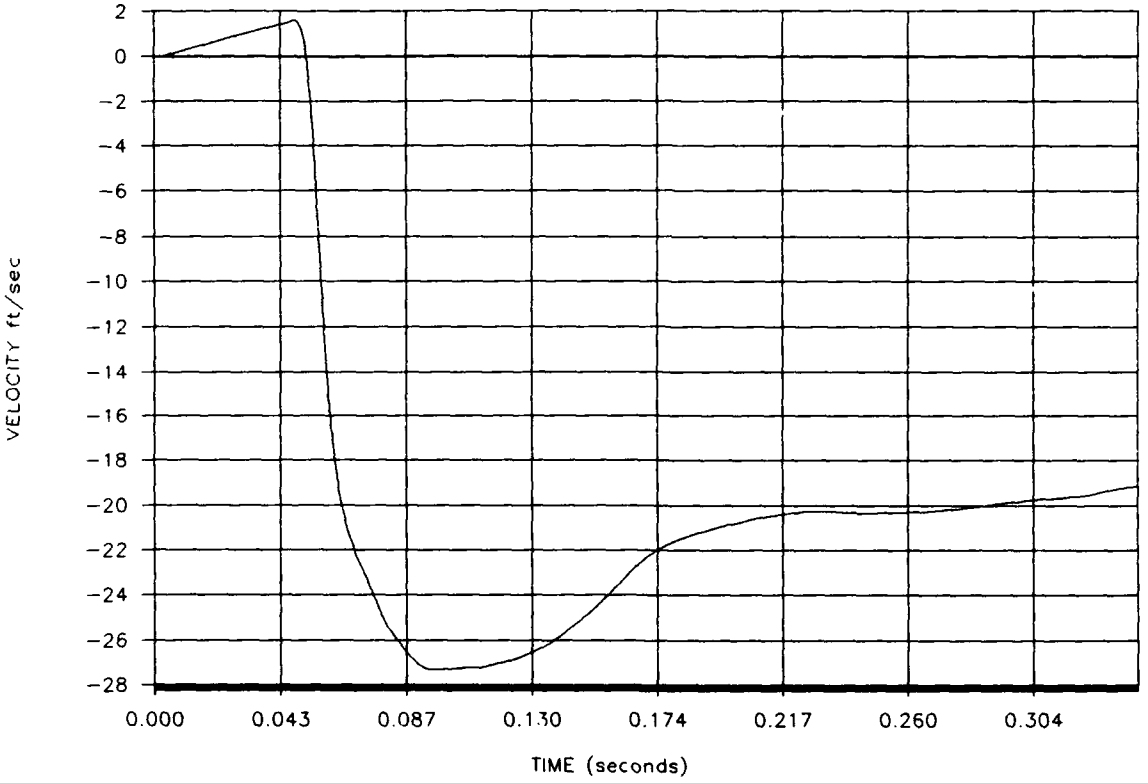
CH 22


2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
VELOCITY ft/sec (Thousands)
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

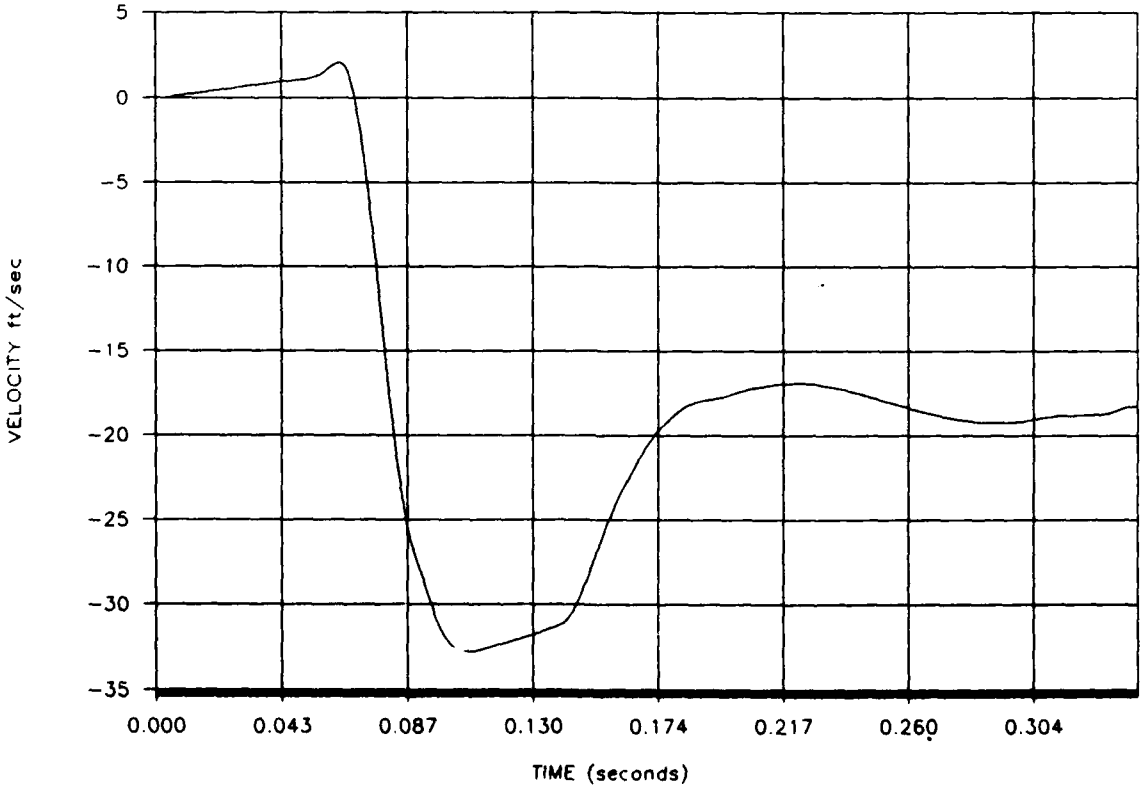
CH 26


5
0
-5
-10
-15
-20
-25
-30
-35
VELOCITY ft/sec
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

CH 28


2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
VELOCITY ft/sec
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

CH 29

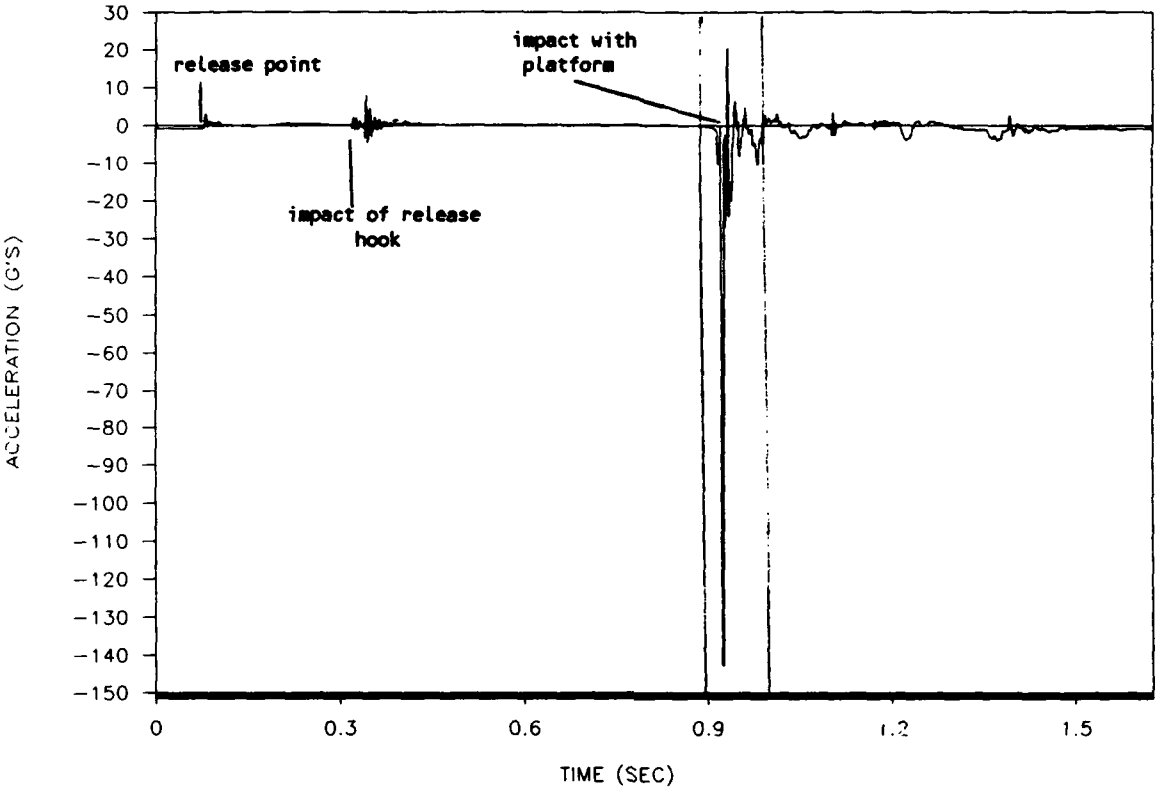

5
0
-5
-10
-15
-20
-25
-30
-35
VELOCITY ft/sec
0.000
0.043
0.087
0.130
0.174
0.217
0.260
0.304
TIME (seconds)

APPENDIX C

TIME HISTORY PLOTS

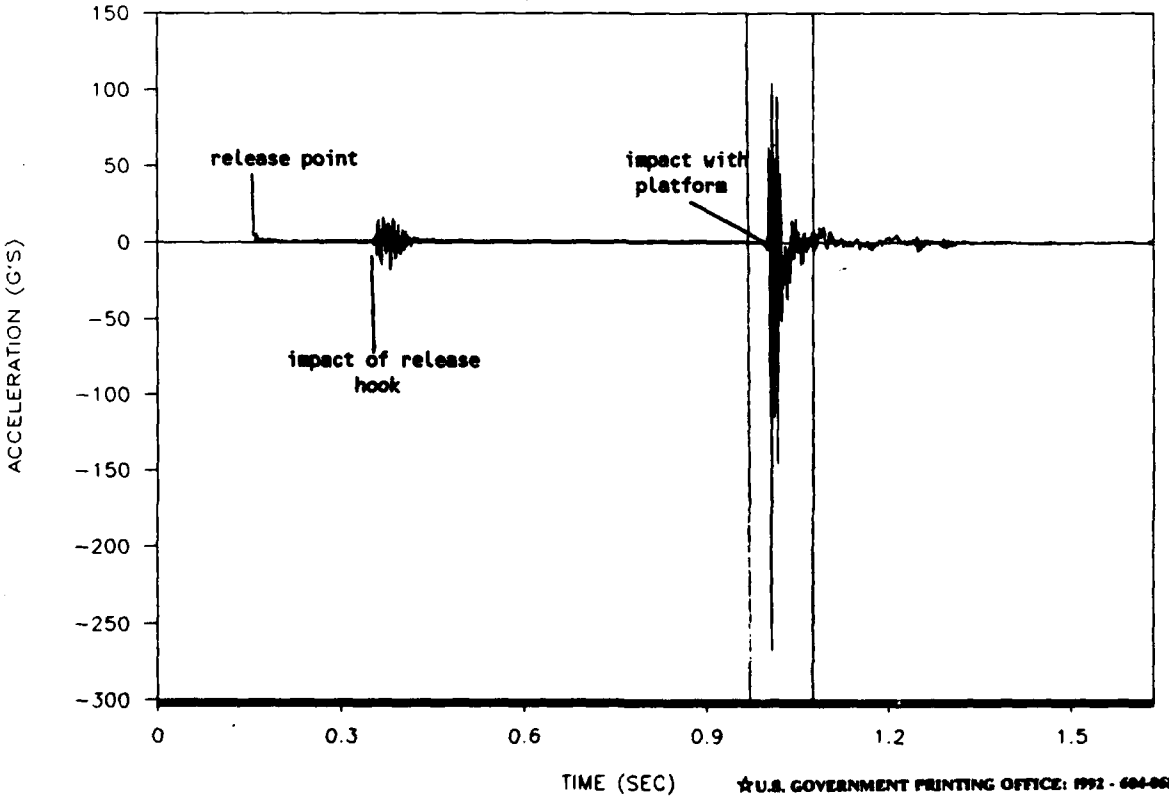
CESSNA 421B VERTICAL DROP TEST1

CH1, TOTAL TIME HISTORY



CESSNA 421B VERTICAL DROP TEST2

CH7, TOTAL TIME HISTORY



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